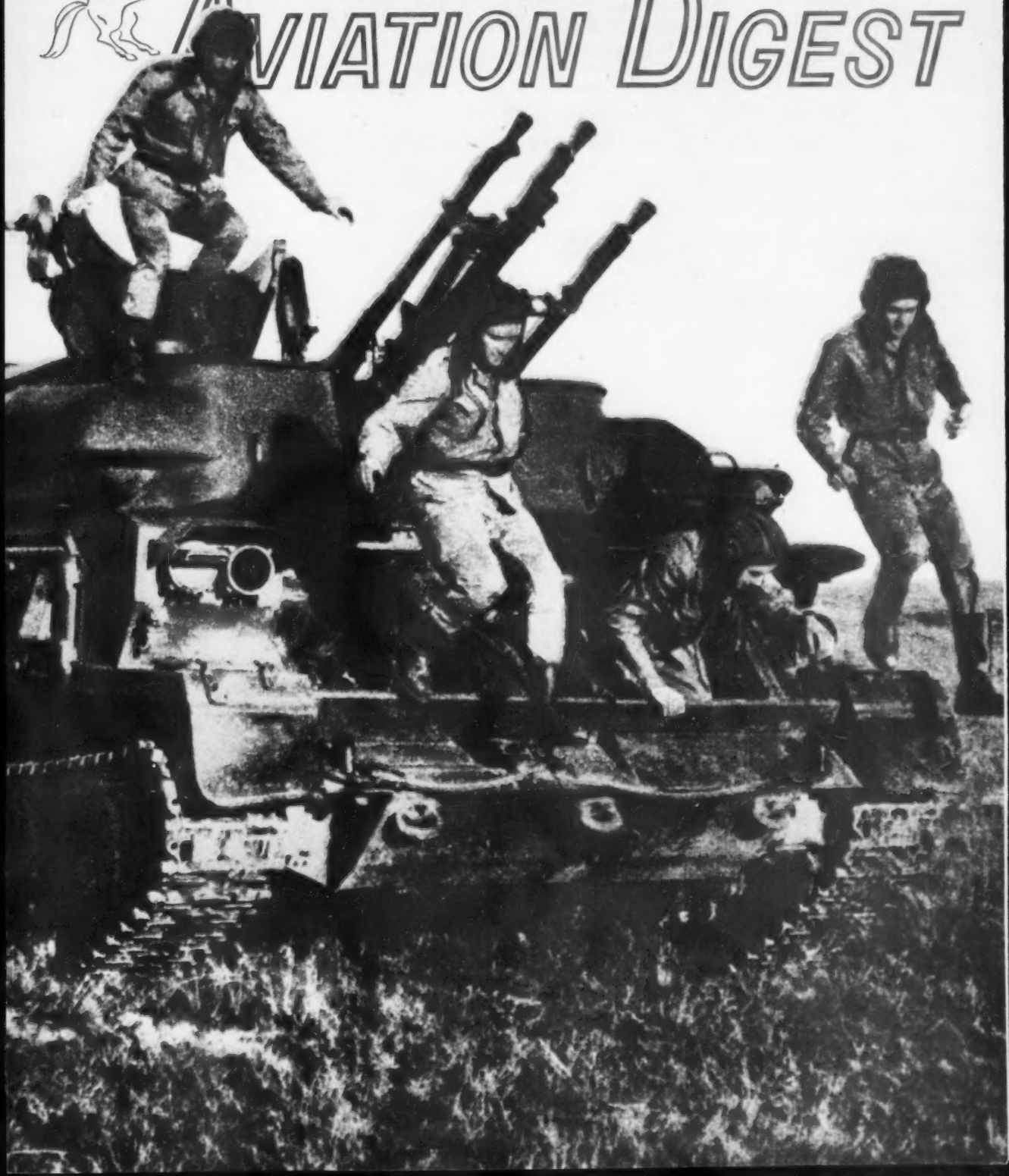
UNITED STATES ARMY

MARCH 1976

AVIATION DIGEST



UNITED STATES ARMY AVIATION DIGEST

MARCH 1976 VOLUME 22 NUMBER 3

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VANGUARD OF FREEDOM
BICENTENNIAL 1775-1975
UNITED STATES ARMY

MG William J. Maddox Jr.
COMMANDER
U. S. ARMY AVIATION CENTER
A major activity of the
U. S. Army Training and Doctrine Command

COL Norman W. Paulson
COMMANDER
U. S. ARMY AGENCY FOR AVIATION SAFETY
A major activity of the
Inspector General and Auditor General
of the U. S. Army

Richard K. Tierney
EDITOR
U. S. ARMY AVIATION DIGEST

ABOUT THE COVER

The *DIGEST* thanks the Foreign Science and Technology Center for the cover photo of Soviet ZSU-23-4 antiaircraft gun crewmen during training exercises. See "Self-Propelled Antiaircraft Gun, The ZSU-23-4" on page 18

The mission of the *U.S. ARMY AVIATION DIGEST* is to provide information of an operational or functional nature concerning safety and aircraft accident prevention, training, maintenance, operations, research and development, aviation medicine and other related data.

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Articles, photos, and items of interest on Army aviation are invited. Direct communication is authorized to: Editor, U.S. Army Aviation Digest, Fort Rucker, AL 36362.

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Colonel Jim Patterson's views on idea exchange (page 3) will help us all learn from the experiences of others. For this reason, General Hill's chronicle of the 1972 NVA offensive (page 4) should be of great interest to many who did not participate in the important campaign that he describes. To profit from reading General Hill's comments and to best utilize them in planning future tactical operations, remember that the next battlefield probably will be quite a different affair. In the first place the enemy likely will be equipped with greater sophistication, particularly if we are contemplating a fight in Europe or the Middle East. Second, our equipment has changed markedly as have our tactics.

I won't belabor this point, but would like to examine the employment philosophy of attack companies and cavalry troops. Although both utilize scout and attack helicopters, the purposes and tactics of each organization differ substantially. This fact has tended to be forgotten because of our own experience. In the last years of the Vietnam War, few military actions started out as heavy combat. Normally they were initiated as part of a search for contact on the part of reconnaissance elements. Remember that we not only probed with air cavalry formations, but also broke our lift elements down into small five-ship packets accompanied by two or three gunships. Thus the opening game was reconnaissance. Once contact was achieved, we then piled on with air-lifted infantry and whatever fire support we could bring to bear on the situation.

Even in such a situation, the area of contact normally was small and our Cobra fire support generally was piecemealed by fire teams. Seldom did we operate our Cobras as a full platoon as we did earlier in the war.

Aviation to be truly central in the next war must bring its heavy hitting power to bear in greater numbers than we ever did in Vietnam. Our new hitting power includes a genuine capability to kill tanks and other hard point targets: At Kontum in May 1972, we killed tanks with helicopter borne TOWs —but mounted on only two R&D UH-1C Huey helicopters. What we will need to do is band together an aggregation of TOW equipped Cobras to make a big impact at the point of decision. This is known as massing and is not unlike massing of tank formations or artillery or tactical air. Each of these combat elements has preached massing for many years. After all, mass is a principle of war.

Another principle of war is security. One of the lesser included offenses of security is reconnaissance. Thus mass and security are two different functions in aviation. The attack company with its 21 Cobras is a mass type organization while a cavalry outfit with its nearly equal mix of guns, scouts and lift ships is a security type organization. Obviously on occasion one organization may have to perform the function of the other, but it is not designed to do this as a principal function.

Now let's examine the attack company. Its mission is to *kill* things. While it uses scout aircraft, they are not preponderant and, in fact, are subsidiary to the killing function. The principal vehicle in an attack company is the attack helicopter and this is where the unit commander should be located. On the other hand, in the cavalry troop, the mission is to *see* things. It is not always necessary to kill what is seen. In fact, in reconnaissance, the job normally is to observe and report and not get tied down to killing. The recon organization, whether ground or air, usually tries to keep from getting decisively engaged. It fights only to free itself to continue reconnaissance.

Refer to Acronym Key on page 5

Military history is loaded with examples where commanders neglected the security function and lost their battles. In Operation Lam Son #719, the Vietnamese corps commander was concerned about North Vietnamese infantry close to the wire at Fire Base 31, one of the key friendly positions in Laos. He directed his reconnaissance squadron commander, Colonel Bob Molinelli, to abandon his reconnaissance mission in favor of providing fire support close in to the fire base. Late in the afternoon, the clouds descended around the fire base and a number of North Vietnamese tanks appeared on the perimeter almost simultaneously. In the ensuing fight, with the attack helicopters forced out of action by weather, Fire Base 31 was lost. The lesson is clear. Had the corps commander continued to provide reconnaissance around his fire base, adequate warning of the approach of tanks would have occurred. Then appropriate counteraction could have been initiated some distance from the fire base.

Therefore, the scout is the principal mission element of the cavalry troop. It is the eyes of the organization and this is where the leader should fly. The attack helicopters merely cover the scouts to help the scouts do their mission. How do scouts operate in an attack company? They may well make the initial contact and may well lead the attack helicopters into firing position. However, once the attack helicopters join the battle, the scouts must move aside and let the big boys mix it up. The scouts cannot continue to function as middlemen and designate each target to the guns. Rather they must stand off, keep score and provide flank reconnaissance to prevent the

attack helicopters from being surprised. Once introduced to the enemy, the guns can take it from there.

In regard to massing, it is reasonable to expect that companies and even battalions may be committed at the same time. Of course, in dealing with aircraft, all of the operational equipment probably will not be engaged at any single point in time. A more normal battalion situation would involve one company on the firing line with a second rearming and refueling and the other company coming or going.

Refer to Acronym Key on page 5

This is the sort of heavy battle for which Jim Patterson's air cavalry combat brigade is designed. If you cannot visualize the massing of attack helicopters, then there is no justification for such a heavy outfit as the ACCB. Instead we would have a collection of individual attack companies scattered across the front. This would deny the Army the new capabilities of the helicopter. It also would condemn us to a peripheral role in a battle involving national survival.

So, as you read General Hill's letter, understand that the mechanics and the principles he illustrates are sound, and also remember that the next battle will be fought over a vastly larger scale.

MG William J. Maddox Jr.
Commander
U.S. Army Aviation Center

COL Patterson:
Outstanding paper. I am especially interested in General Hill's thoughts on scout-Cobra interface.
His theory, which incidentally I adhere to, that all scouts may not be able to work with all guns just may dictate our training and task organizing techniques.

LTC Donald R. Martin
Commander
7th Squadron, 17th Cavalry

COL Patterson:
A darn good word picture of what it is all about—also, some good ideas which should be looked at.
I would like a copy for my reference file.

LTC Phillip J. Haan
Commander
4th Squadron, 9th Cavalry

COL Patterson:

I certainly can't take issue with [General Hill's] observations on maintenance. Emphasis on night repair and reinforcing the sheet metal effort were fundamental with me when I had the 190th Assault Helicopter Company in Vietnam.

The area of problems concerning armament and avionics is something we've already come to grips with. As you know, we have both an armament and avionics shop in the 6th [Cavalry Brigade (Air Combat)]. Both these shops have technicians we employ as quality control inspectors who assist the squadrons to technically inspect their aircraft during PEs. They also assist the squadrons to troubleshoot aircraft during unscheduled maintenance.

For a long time our situation wasn't any better than that described by the general, but it appears as a result of awareness and your new ESC reporting, we're getting healthier by leaps and bounds.

LTC Charles U. Vaughn
Commander
34th Support Battalion

Editor
U.S. ARMY AVIATION DIGEST
Fort Rucker, AL 36362

Dear Dick:

Professionals in every walk of life need to communicate with each other to—as a minimum—exchange ideas, lessons learned and motivate each other to learn all there is to know of their chosen life-work: This requirement applies particularly to our profession in arms. None of us have a monopoly on knowledge, nor do many of us have all the answers we need to successfully prosecute our missions. Indeed, I have found that in the business of aviation support to the combined arms team, there are still many unanswered questions. Unfortunately, some persons are prone to provide questions and not work hard enough to seek the answers.

There is, and has been in some circles, professional disagreement about the use of attack helicopters, air cavalry, aero scouts and air assault aviation in our Army. Recently, great strides to provide common baseline doctrine and tactics have been promulgated and published by TRADOC. Yet, I'm equally sure there is still much left to be done. Experts in the field are many; some are self-professed, and will (do) not share their wisdom with others. Far too many of the professionals who possess the needed expertise are seldom heard from.

As the commander of the 6th Cavalry Brigade (Air Combat), I have concluded that while we in this brigade do possess real expertise in the business, there are many others who need to be heard. To this end I have asked many to correspond and communicate with us—and we with them—sharing the wisdom and hopefully improving through innovativeness and initiative the tremendous value offered the combined arms team with the aviation support we in the business can provide.

One of the sources we have tapped is Major General John Hill, an Army aviator, who was directly involved in the only combat employment of the aerial TOW. The battle of Kontum, Vietnam, was the setting, and Major General Hill (then a brigadier general) was the commander of the 197th Light Infantry Brigade assigned the mission to defend Kontum. Major General Hill is now Deputy Commanding General, III Corps and Fort Hood. I recently had the distinct pleasure to discuss with him his tactical experience with aviation in the Kontum action. After listening to him relate his use of air cavalry and aerial TOW, as well as his other combat experiences there, I requested he convert what he told me to writing so that others might share the valuable lessons he learned at that time and in that place. This he did, and when he did, he authorized me to use his letter to "spread-the-word."

While I recognize, as does Major General Hill, that though his actions and conclusions worked at Kontum, they may not have direct application in all other circumstances. His opinions and judgments, however, do represent the only combat experience of its kind that I am aware of. For this reason alone, I value his letter and his judgment and recommend that, like we in the 6th Calvary Brigade (Air Combat), others be afforded the opportunity to hear the word and heed carefully the lessons we need to know to be able to win the first battle.

Enclosed for publication is Major General Hill's letter [page 4] to me outlining our conversation. My hope is that Army professionals everywhere will read and listen. As a minimum, we owe it to all Soldiers who might be involved in similar lessons should the circumstance ever arise. Comments by my battalion and squadron commanders are also enclosed.

Colonel James H. Patterson
Commander
6th Cavalry Brigade (Air Combat)

"In keeping an air cav troop operational, the key item which determines your total available effort is the number of Cobras that can be kept operational."

Colonel James H. Patterson
Commander
6th Cavalry Brigade
Fort Hood, TX 76544

Dear Jimmy:

When we talked the other day you asked that I provide in written form my thoughts on air cavalry based on my operations in MRs I, II and III RVN over a three-year period. Hence this letter, in which I'll discuss maintenance, the organization of the reconnaissance element for battle, some desirable changes in the troop structure, the use of the TOW and finally the job of the reconnaissance commander.

I start with maintenance because maintenance is like the ante in a poker game. Without it you are not allowed to play. Improved maintenance efficiency can provide as much as a 100 percent increase in effective operational effort. Some of the key items in getting this increased efficiency are standard practice, such as ensuring that the right airplanes are flown into PE so as to ensure 100 percent utilization of PE crews' time. Some of the others are not so standard. For example, many units try to schedule their maintenance crews on the same timeframe as their flight crews. Thus, an airplane that goes down today may not be repaired until tomorrow. I have found it essential to place my maximum maintenance effort during the minimum flight times, i.e., at night. Paraphrased, if the pilot breaks it today, I want the maintenance officer to fix it tonight so that the pilot can break it again tomorrow.

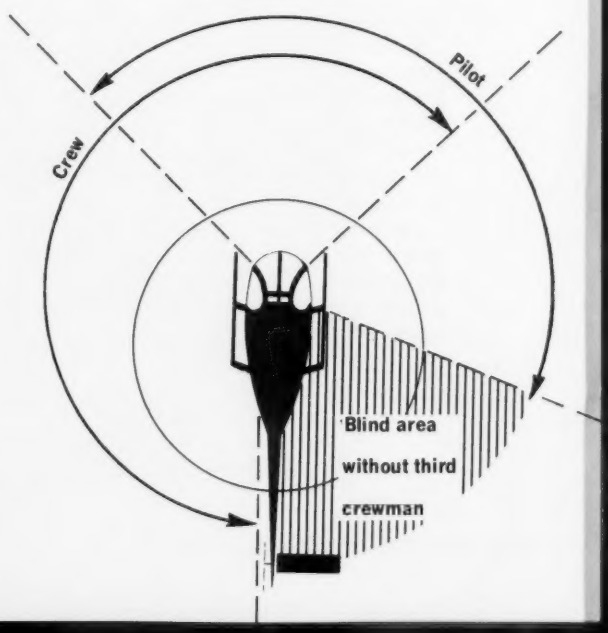
In keeping an air cav troop operational, the key item which determines your total available effort is the number of Cobras that can be kept operational. This aircraft presents a particular problem because of deficiencies in our current maintenance TOE.

". . . the Cobra . . . used as a scout reminds me of using an M-60 tank on the ground for scouting—seldom if ever a good thought."

Specifically, we do not have quality control personnel in either armament or avionics. As a result we frequently find that the airframe and engine are in good condition but the aircraft is nonoperational because the turret is not working. (This is no different from the problem we have with tanks and particularly those with electrical turrets.) On the airframe and engine side you have an inspector who makes the initial inspection, hopefully provides you a sound parts list, tells the mechanic what to do, inspects the work in progress and finally certifies the work at the end of the job. This inspector is substantially more experienced than the basic mechanic. By contrast, in turrets and avionics, the same man both makes the inspection and does the work. We thus lose our checker and end up relying on comparatively inexperienced men to get these two systems operational. It simply does not work and until we get the TOE changed, any troop commander is going to have to give special attention to this facet of maintenance.

Turning to the AO—I have utilized B models [UH-1 Hueys], OH-6s, OH-58s and Cobras for the scout mission. I found them all satisfactory except the Cobra, which used as a scout reminds me of using an M-60 tank on the ground for scouting—seldom if ever a good thought. While I preferred the 6 to the 58 due to its greater acceleration, the 58 performs

Figure



Maintenance man inspects assembly of 7.62 minigun on chin of Huey; Bien Hoa, 1968

Crewman checks ammunition belt of 40 mm grenade launcher on a Cobra gunship

adequately. With either the 6 or the 58, however, there is insufficient capacity to add miniguns and try to make the aircraft a poorman's Cobra. This can only be done by reducing the crew to two or overloading the aircraft. When the crew is reduced to two, the sector to the right rear tends to be underobserved (see figure). This is dangerous. If the third man is carried, in addition to the minigun, to observe that sector, the aircraft becomes marginal for weight and when required to come to a hover, tends to spin out. Even without the third man, weight can be a problem. Several of our crashes of OH-6s on high density days, I believe, were due to the pilot attempting to cover this right sector by hovering, turning and losing control of the bird.

As you note from the sketch in the figure, I prefer the three-man crew so as to cover both sides with a pair of eyeballs. It also provides the ability to land and dismount two men to investigate something on the ground. We did not do this often but I believe operations could be improved by emphasizing this dismount capability.

Turning from the individual aircraft team to the reconnaissance team, I have tried a pair of B models covering each other, a pair of 6s covering each other, guns covering both the above configurations, and finally a 6 or a 58 covered by either one or two guns. I much prefer the latter arrangement. The B model did not, of course, have the ability with its load to hover and nose around the way our present scout birds do. But even beyond that, I found that when you put two scouts down, the lead scout tends to fly in comparatively gentle turns along an axis so as to enable the number two man to cover him. This flight pattern increases his vulnerability and the number two man is unable to cover him effectively because neither the standard B model, nor a second scout aircraft has adequate firepower to cover the exposed lead. The B model rigged as a Hog or a Cobra, however, has that firepower and once the scout is fired at, presuming the gun is in proper position, he can quickly break the scout loose. Whether it was the old UTT company with the Hog, or our present day arrangements, rapid firepower delivered when the scout comes under fire cannot be overemphasized. Good guns don't lose their scouts. Careless guns get their scouts killed.

This last statement leads me to my next point—we

Continued on page 28

Acronym Key

NVA:	**North Vietnamese Army**
Cobra:	**AH-1 HueyCobra, more commonly called the "Cobra." It is an attack helicopter**
Scout:	**Currently the OH-6 Cayuse and OH-58 Kiowa helicopters. They are used for observation and reconnaissance**
TOW:	**Tube-launched, optically-tracked, wire-guided missile**
R&D:	**Research and Development**
Guns:	**Attack helicopters**
ACCB:	**Air Cavalry Combat Brigade**
TRADOC:	**U.S. Army Training and Doctrine Command**
MR:	**Military region**
RVN:	**Republic of Vietnam**
PE:	**Periodic maintenance**
TOE:	**Table of organization and equipment**
AO:	**Area of operations**
UTT:	**Utility Tactical Transport Company**
Hog:	**UH-1B Huey armed with the XM-3 (2.75 inch rockets) and the M-5 (nose-mounted 40 mm grenade launcher)**
NOE:	**Nap-of-the-earth**
11Ds:	**Infantrymen specialized in scouting**
QC:	**Quality control**
MASSTER:	**Modern Army Selected Systems Test, Evaluation and Review**
ACSFOR:	**Assistant Chief of Staff for Force Development, at Department of the Army level (no longer in existence)**
Slick:	**A UH-1D troop-carrying helicopter, sometimes armed with doorguns**
ESC:	**Equipment serviceability criterion**

The New
DEAD-MAN'S CURVE

Colonel William R. Ponder
Deputy for Combat Developments
United States Army Aviation Center

Threat awareness, combat training and proper materiel reduces the "Dead-Man's Curve" to a size conducive to success on a high threat battlefield

"STAY OUT OF the dead-man's curve," the instructor pilot (IP) warns his student. The attentive aviator obeys. The heedless flyer allows his aircraft to get into trouble and realizes with thought-provoking suddenness that his IP was not crying wolf. The difficulty he finds himself in is of his own making.

In years gone by all helicopter pilots were warned to avoid continuous operation in the dead-man's curve (figure 1). The Army's current NOE (nap-of-the-earth) training program and terrain flying allow the aviator to successfully operate his aircraft in the dead-man's curve to accomplish his mission in support of the ground commander, provided he is NOE trained and maintaining his flying proficiency. Detailed training requirements can be found in FM1-1.

When he does battle against armor on the modern battlefield, the Army aviator confronts another, and more dangerous, "dead-man's curve." The red striped area of figure 2 illustrates this greatly enlarged curve created by the enemy threat. We can see that the "threat" curve dwarfs the "aircraft" curve (depicted in solid red) in comparison, and forces the aviator to operate in the solid black area of figure 2. The difficulty the aviator faces here is not necessarily of his own making. The added danger lies in the brain of the enemy gunner. The shape and size of the danger area are functions not only of the range and accuracy of the enemy weapons but also of the wisdom and training of the antiaircraft gunners; but, more important, the extended combined arms suppression of threat weapons.

Basically, we can say the farther away the target, the less the chance of scoring a hit. But opposing minds complicate matters, and this modern battlefield dead-man's curve becomes a function not only of the enemy's wisdom and training but also of ours. We know the tanks are sitting ducks for the AH-1 Cobra TOW (tube-launched, optically-tracked, wire-guided) without the protection of the ZSU-23-4 (see page 18). We also know the Quad-23 gunner employs radar to acquire us as targets, and if his radar doesn't work, he is forced to fall back on his eyes. So we use chaff to deny him radar acquisition and smoke to blind him. The deadly area under the curve thus becomes smaller and we can successfully operate in the black area. Night and tactical instrument flight can be accomplished at low levels in the black and/or gray areas.

The enemy gunner also knows that neither his radar nor his eyes can penetrate solid terrain features and buildings, so as he closes with the enemy, our aviator takes advantage of the masking afforded by both. In addition the Army aviator may have a radar warning receiver on board to tell him when enemy radar is attempting to acquire him. Forewarned is forearmed, and never more so than in this situation.

For additional information on this subject see "'Above The Best' But Below The Threat" by Captain Lewis D. Ray, page 19, *AVIATION DIGEST*, February 1976

While the Cobra TOW pilot has a distinct range advantage over the Quad-23, he may want to get nearer to increase his chances of destroying the weapon and thereby exposing the accompanying enemy tanks to the devastating fires of over-watching Cobra TOWs. To reduce the risks, he flies nap-of-the-earth to his desired position, pops up and fires his TOW missile. Or he may call in smoke and chaff from friendly artillery and helicopters to screen his aircraft from the gunner's view and jam his radar.

When we look at it from the right perspective, the modern battlefield "dead-man's curve" does not seem so formidable. Knowledge of the threat keeps us from carelessly getting into the enemy's effective range. We must bring our combat know-how to bear against the enemy and degrade his target acquisition capability.

In short, threat awareness, combat training and the proper materiel equip us to reduce this new "dead-man's curve" to a size conducive to our success on the first high threat battlefield.

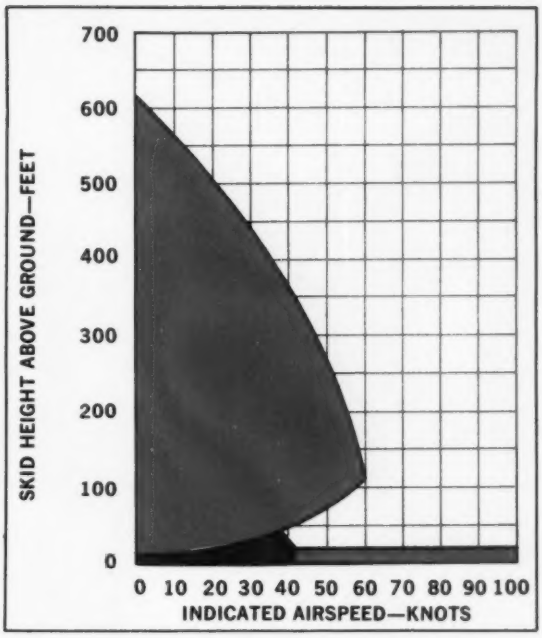
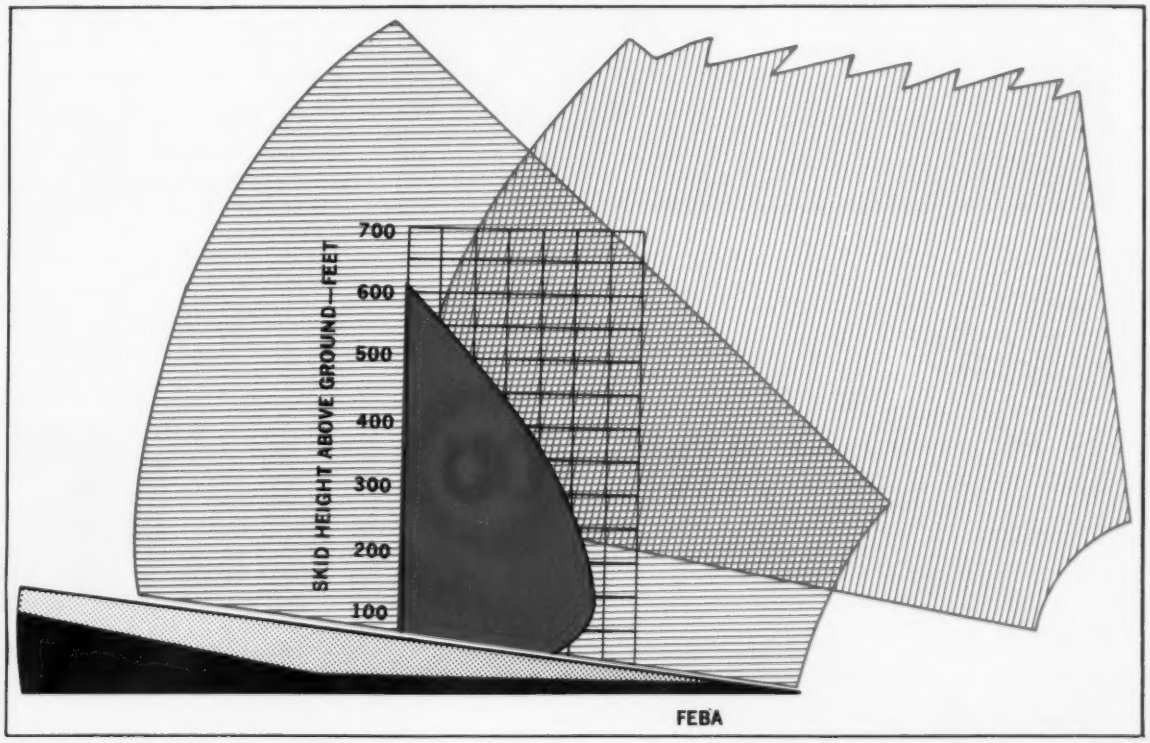


Figure 1
Aircraft Dead-Man's Curve

Figure 2
Modern Battlefield Dead-Man's Curve



BEFORE . . .

LOOK, I KNOW NOE is the way we'll have to go in this area. But how in the round world am I supposed to navigate using this stupid map? It doesn't even look like the area. I mean, day before yesterday I was flying over here and there were ponds and trees and other stuff out there that weren't on the map. Who makes these dumb maps anyway? Why can't they get these things squared away? It's tough enough, flying at this altitude, as it is."

Yes, flying nap-of-the-earth (NOE) today is tough. And it's tough enough without adding to your frustrations maps that don't correspond to terrain features. You end up looking for things that aren't there and seeing things you didn't expect to see. Perhaps your task would be eased if you had a better understanding of some of the principles mapmakers use to guide them in the art of mapmaking—or cartography. At least you could understand why maps are the way they are. And, knowing this, maybe your skill in map interpretation and your confidence in your own ability to navigate can be enhanced.

Interested? Read on!

ANNUAL AWARD
Monthly Winner
CONTEST

ARE YOU NOE

AND LOST?

Garvin L. Holman, Ph.D.

U. S. Army Research Institute Field Unit
Fort Rucker

For our readers not familiar with NOE flight: In an attempt to counter the high antiaircraft threat anticipated on the modern battlefield, Army aviators must fly as close to the ground as possible. This tactic allows the helicopter to move about taking advantage of terrain and vegetation to hide it from the enemy. Flying at minimum altitude also requires that the aircraft be flown at speeds that vary from hover to V_{ne} (velocity never to exceed) for reasons of obstacle avoidance and maximum masking. Likewise, headings will also vary to maintain masking. The major characteristics of nap-of-the-earth flight are minimum altitude and variable speed and heading to take maximum advantage of terrain and vegetation for masking while moving to a preselected point.

When flying this type of mission, do you often get lost? If not lost, are you unsure of your exact position? Are you confident that you have found the initial point or the landing zone? If you have doubts about your navigational accuracy, you are not alone. A study completed two years ago by the Army Research Institute (ARI) indicated that almost one-half of such missions as described above, when flown by operational pilots, would have failed because of difficulties in navigation. What are these navigational difficulties? And more important, what can we do about them?

One of the difficulties faced by the NOE navigator is that of *perspective*. The map being used represents the terrain being flown over as it would appear from an altitude of several thousand feet. From high altitudes, a pilot can look down on the area and see streams, roads, fields and other terrain features very much as they appear on the map in his lap. At NOE altitudes, the perspective the navigator has on the terrain is not at all like the perspective presented on the map. Streams and roads and other features are no longer laid out below in a nice pattern, but instead, appear in the distance at heights very close to the observer's height. Many features found on the map are masked by vegetation and terrain just as the helicopter is masked from enemy observation. The navigator's usual field of view is limited to the terrain very close to the aircraft, 100 to perhaps 500 meters, and maybe to higher ground that may be visible several kilometers away.

A *second*, and related, major difficulty the navigator has is *interpreting* the tactical map being used. All of us have had mapreading courses in which we were taught to "read" the map. The typical mapreading course presents material on map coordinates, contour lines, scale factors and such, and has the student memorize the symbols for various manmade features such as roads and buildings. The resulting skill is limited and is not enough to navigate nap-of-the-earth.

The NOE navigator must learn to interpret the map in much more detail than is learned in the typical mapreading course. This requires a knowledge of the cartographic (mapmaking) principles that are used in drawing up the map. For example, in order to determine what a small pond symbol on the map will represent in the real world, the aviator needs to know what size criterion the cartographer used in plotting that symbol. Therefore, with more extensive map interpretation skills, the navigator develops the ability to visualize, from NOE altitudes, what the terrain should look like from its presentation on the map.

The *third* major difficulty faced by the navigator is that of *terrain analysis*. In many respects, this is the opposite of the problem on map

interpretation. The NOE navigator must be able to look at the terrain from NOE altitudes and visualize, through knowledge of mapmaking principles, how that terrain would appear on the map. Again, this type of skill is not taught in the usual mapreading course.

How can these problems be solved? The same research mentioned above by ARI indicated that these skills could be taught to Army aviators and that with the acquisition of these skills, navigation performance could become much more accurate. In order to teach these skills to Army aviators, Army-wide, ARI has sponsored the development of two courses designed to teach these skills of map interpretation and terrain analysis. One course currently is undergoing implementation and evaluation in the Initial Entry Rotary Wing (IERW) courses at the U. S. Army Aviation Center. In the near future, the second course will be available to operational units.

The new Map Interpretation and Terrain Analysis Course (MITAC) uses well-developed principles of learning and instruction to teach NOE navigation skills. The course materials emphasize cartographic principles, map interpretation and terrain analysis in active practical exercises that stress student participation and performance. The first few lessons are comparatively simple. As the student progresses through the course, exercises become more and more difficult until, at the end of the course, the exercises present problems as difficult as actual NOE navigation.

The MITAC assumes the student has a knowledge of classical mapreading and does not try to teach grid systems, coordinate reading, or the memorization of a variety of symbols. Instead, the course teaches the cartographic principles that the mapmaker used in producing the tactical map. The student learns about the functional criteria the cartographer used in portraying such features as rivers and other bodies of water, roads, terrain features such as the form of hills, and ridges, slope gradients, vegetation features and manmade features as well.

Consider again an earlier example, the portray of small ponds. On the usual 1:50,000 scale tactical map covering a nonarid region, the cartographer has almost certainly plotted to scale all ponds 100 meters across or larger. Ponds less than 40 meters across most likely are not plotted at all. Ponds between 40 and 100 meters across may or may not be plotted. The drier the area covered, the more likely it is that this size pond has been included. In quite arid regions, the cartographer will portray any source of water no matter how small it may be.

Armed with this knowledge of cartography, the NOE navigator is much better able to judge what a body of water portrayed on the map will look like when seen on the ground. Likewise, he is better able to judge whether or not a small pond seen on the ground will be portrayed on the map. Cartographic principles such as this example are taught in the MITAC using a textbook and in slide-illustrated lectures. Knowing this, the aviator in our opening paragraph would have been much less confused.

With this as background material, the practical exercises begin. The early exercises start teaching the perspective of nap-of-the-earth altitudes and map interpretation skills. The student is required to study a map plate and identify various terrain features near a given route marked on the map that would be visible from an NOE flight over that route. His selection of visible features is then checked by viewing a wide-angle movie of an NOE flight over that route.

Typical early performance indicates that the students believe that a great many features would be visible during NOE flight. As the course progresses they learn that, at those very low altitudes, very few features are actually visible and the visibility depends upon the masking effects of terrain and vegetation as well as distance from the helicopter.

To further increase map interpretation and terrain analysis skills, another exercise requires the students to compare a wide-angle picture of a piece of terrain with five positions marked on a tactical map. The task is to determine the position from which the picture was taken. The first such exercise seems easy. The picture shows a body of water in the foreground, some low hills in the middle distance and some higher hills in the background. It should be a simple matter to pick that out on the map. Inspection of the five choices marked on the map reveals that they all have water and hills in about the same configuration as described above. To pick the correct location, both the photo and the map must be inspected and interpreted in detail. Is the water seen a pond or a creek? Is a dam indicated? Which of the near hills has the steepest slop gradient? Do the hills in the background give any clues? At the end of the fifth exercise of this type, the students are much more proficient in interpreting the map and analyzing the terrain. The importance of these skills is pointed out in another NOE filmed flight in which the five positions used in the exercises are crossed and used as possible checkpoints.

As the exercises continue and the students' skills increase, the tasks become more difficult and more closely approximate the complete NOE navigation task. In the next exercise the students follow a filmed NOE flight on a tactical map upon which the route is designated. A typical task in this part of the course is for the student to mark his map indicating the location of the flight at any time during the course of the presentation. Preparation for these exercises be-

gins with extensive preflight study of the route and the surrounding terrain on the map. Students are encouraged to discuss the route with one another, pick out checkpoints and compare interpretations of the map indications. It is important for the students to learn good preflight map study habits early in their NOE curriculum since this habit is one of the major factors that contributes to a successful NOE flight. Aviators should learn early that an hour is not an unusual amount of time to spend in planning an NOE route and studying the map.

The flight is then briefed by the instructor who points out significant features on the map to ensure that no one begins the flight without a minimum of route analysis. After a few exercises of this type, the students are doing a much better preflight analysis than the instructor briefs. This is how it should be.

The students then "fly" the route via wide-angle NOE film and try to keep track of their position on the map. At certain times the instructor will call for a position mark and the students mark their maps along the route to indicate their present position.

A very important part of the instructional sequence of MITAC is a detailed postflight debriefing given by the instructor. In this debriefing, the students score their maps and monitor their own progress. The instructor reruns the flight, pointing out terrain features that could be used for orientation on both the film and the map. This reinforces the students' correct associations and better prepares them for the next exercises. When students can follow a given route with reasonable accuracy, they are ready to proceed to more advanced exercises.

In the more advanced exercises the same sequence of preflight study, preflight briefing, filmed flight and postflight debriefing and study is maintained. In these exercises students follow a flight along a designated route but with deviations from the marked route. Their task is to indicate on their maps where the flight deviated from the preplanned route, where it went and where it rejoined the route. This gives the students additional practice in along-route orientation and introduces them to cross-route errors and orientation. This type of exercise is very much like an actual NOE flight that begins on course and then goes off course by making a turn too early or too late. In actual flight a navigator must detect these errors as soon as possible and determine where the flight went off course and where it is now. This exercise requires students to practice skills needed for this kind of incident.

In the last exercises the students are given a map without a route marked. Instead, an initial point is specified and a corridor of operations is marked. The students' task is to trace on the map the actual route of a filmed flight. In addition, they must mark the exact location of the flight when an instructor requests it. This is a very difficult exercise but can be done using the map interpretation and terrain analysis skills developed in the earlier parts of the course. Once again, the key to success in this type of exercise is preflight map study. The corridor of operations must be studied very closely and major terrain features visualized from NOE altitudes, even sketched if that is possible, to aid their recognition in the filmed flight. In many respects these exercises are more difficult than actual NOE navigation due to perspective differences in filmed flight as opposed to actual flight. However, they serve to sharpen the students' map interpretation and terrain analysis skills to better prepare them for actual flights.

During the initial test we have had NOE instructor pilots insist on doing one of these last exercises without going through the previous ones, and then ending up completely lost and disoriented. To say the least, this got their attention. After completing the course, they said they learned more about NOE navigation in a few days than they had over the past several years.

Although final evaluation of the course has not been completed, early reports are that these techniques of instruction are also very effective with IERW student aviators. ARI is evaluating the MITAC to determine just how effective it actually is in teaching NOE navigation skills and to improve it as may be necessary. An improvement already underway is a programed text that will teach the relationship between contour interval as seen on a tactical map and the actual slope gradient. Other improvements are the development of some map interpretation aids such as a contour reading template and a terrain sketch kit.

The biggest change for operational units is the development of the MITAC into a format that will make it suitable for unit training. The modified format will allow for individual or group training without the need of specially trained instructors to present the course and manage the complex briefings and exercises. The course was to be available for unit use last month (February 1976).

Even without this new course, there are several things pilots can do to improve their NOE navigation skills. The most important areas to work on are map interpretation and terrain analysis. Improving these skills also will aid in solving the perspective problem.

The first suggestion is to really *study* the tactical map. Realize that it is impossible for the cartographer to put *everything* in the environment on the map. He has had to *select* a fraction of the real world for representation on the

map. Knowing the cartographer's method of selection will tell you what you can expect to find on the map and what you can expect to be left off.

Compare the map with the world and notice how the smaller features such as ponds, clearings and tree-filled areas less than 40 meters across are almost never seen on the map. However, rare features such as small ponds in an arid region or even single trees in an otherwise treeless area may be portrayed on the map.

Notice that many manmade features such as roads, bridges and buildings are portrayed on the map quite boldly. Out in the environment, however, these features may be much more difficult to see and identify. A road may be crossed and not even seen by the aircrew if it was visible for only a few seconds because of vegetation masking. Minimize your use of manmade features in your navigation.

Constantly compare the map with the terrain to learn in what respects the map underemphasizes or overemphasizes various features. Study the contour intervals as they appear on the map and the slopes they refer to in the terrain. ARI has found that most pilots overestimate the steepness of a slope when they see it portrayed on a map. Practice estimating slope gradients from their map presentation and checking your estimates against the actual terrain.

A second suggestion concerns your preflight map study. Select the most advantageous route you can, depending upon the tactical situation, your mission and other relevant factors, and mark it clearly on your map. Study that route and the surrounding terrain and pick out checkpoints.

Go over the route with your pilot and familiarize him with the major features and checkpoints. A good way to do this, and to make sure you have reviewed the route well, is to rehearse the flight on the map. Before your pilot sees the route drawn on your map, point out the initial point on an unmarked map and indicate the first direction he will be flying. Then *describe* the route to him as he will fly it step by step, terrain feature by terrain feature. If he can trace the route you selected from your description alone, you have probably done an adequate map study. You have also ensured that your pilot will not have any surprises in the cockpit as far as checkpoints and major terrain features are concerned. He is better prepared to help you maintain the constant orientation required for NOE flight and will be able to fly the aircraft more confidently.

Preflight map study tends to be shortchanged by the average aviator, probably because it is difficult and boring. But remember, the more map study you do the less difficult it will become. As the time you spend studying a map becomes more productive and less effort, it is also less boring. This in turn leads to more successful NOE flying.

A third suggestion concerns cockpit cooperation and communication. Navigation is a cooperative enterprise between the pilot who must spend almost all of his time looking outside the cockpit in the NOE environment and the navigator who must spend a great deal of his time looking inside the cockpit in order to maintain orientation on a map. The pilot must assist the navigator by looking for and reporting checkpoints and major terrain features. His job is easier if he knows what to look for and the navigator should keep the pilot informed on what to expect along the route. In turn the pilot must keep the navigator informed of what he does see, using a phraseology common to both. The constant exchange of information between pilot and navigator should be practiced at every opportunity and a common phraseology developed to reduce possible confusion.

Finally, a few rules to thumb by: Don't depend on manmade features for primary checkpoints. Natural features are more permanent and usually larger and easier to see. Learn to navigate by reference to hills, ridges, draws, valleys, water courses, etc., and use roads, buildings, bridges, etc., as secondary cues.

Look ahead, not to the side and rear, to maintain orientation. If you know where you are and where you should go, your primary visual references will be in front of the aircraft and there will be little need to search to the side or rear. With a smaller visual area to scan for checkpoints and orientation features, you have a better chance of spotting them earlier and remaining fully oriented. Of course, if you become unsure of your position, take advantage of all possible cues no matter what direction they are in.

Don't trust your map 100 percent. Remember, the cartographer had to select information for map portrayal and not everything is on it. Also, features change—especially manmade features—so exercise caution.

. . . AND AFTER

"WOW! With the antiaircraft threat as bad as it is in this area, I'm sure glad we can go NOE. That new copilot I've got is sure a helluva good navigator too. The terrain didn't look anything like the map but he kept us on course all the way—even up in that unfamiliar country to the north. I don't know how he does it. Do you know he spent over an hour studying the map before this mission? I don't know what he could've been looking at for so long. Anyway, he did a great job. Helped me fly too. Told me what I should see next and right where to turn. Really great!"

The Enemy-Threat Officer

During this time of peace, we in the military must guard against a complacency that would incapacitate our ability to respond decisively to any real threat hurled against our country. Just as a false sense of well-being may be dangerous in our individual professions, complacence and a lack of preparedness could be disastrous to the nation

CW3 Chuck Tidey
Project Pilot
Experimental Vehicle for Avionics Research (RAVE)
Ft. Monmouth, NJ

AFTER REPORTING into his new unit and getting settled in for a couple of days, the newly assigned aviator found himself in his commander's office discussing his past assignments and experience. A few minutes later, he was walking through the orderly room shaking his head in bewilderment. It was not over being assigned to the second flight platoon, but because of his being assigned the additional duty of the unit's *enemy-threat officer*.

"What is an enemy-threat officer and what does he do?" the man asked himself as he stumbled into the S-2 (intelligence) shop at squadron headquarters. The squadron intelligence officer began to fill in the details of what was expected of an enemy-threat officer.

Upon leaving the S-2 shop, the new aviator was walking at a brisk pace. A slight smile could be seen at the corner of his mouth as the thought crossed his mind: At last, an additional duty that meant something.

According to the S-2, the squadron commander felt that his troops weren't informed enough about the threat presented by our potential enemies. When this was brought to his attention, the S-2 quickly agreed. But he pointed out that with his office's current workload, he just didn't see how he could brief and continually update the entire squadron on the threat potential and still get the rest of the required work done properly.

The squadron commander acknowledged that he understood, but that he wanted the S-2 to supervise and make information available to unit enemy-threat officers. It would be the job of these officers to put together briefings on the threat potential of all possible enemy forces and to present this information to their unit's personnel. Their briefings also should include how the threats interact with their unit's missions. The briefings would be given to all personnel on a regular basis just as are safety meetings.

Once a month the unit enemy threat officers meet at the S-2 shop and go over what they have learned in their research for updating their briefings. They offer new teaching techniques discovered during the month.

At his first enemy-threat officer's meeting, our newest enemy-threat officer learned a lot of new ideas. For example, a warrant officer from a sister unit discussed the technique of passing out a test requiring unit personnel to identify a variety of silhouettes of a potential enemy's artillery pieces and armor. A lieutenant from another unit said he had driven home the importance of knowing your possible enemy and what his capabilities are by distributing next-of-kin notices to all of those who failed his exam.

This brings up a question, do you know who your enemy-threat officer is?—or do you have one?

TARGET IDENTIFICATION

Captain Joseph Moore Jr.

Chief, Auxillary Systems and Equipment Committee
Tactics Branch
Department of Academic Training
U.S. Army Aviation Center

THE BALLOON has finally gone up and your attack helicopter unit equipped with TOW (tube-launched, optically-tracked, wire-guided) missiles has been deployed.

As enemy armored units make several breakthroughs and drive deep into our rear areas, your unit moves into blocking positions to destroy targets of opportunity. Suddenly, to your front you see a column of eight armored vehicles coming your way. You take them under fire and destroy all eight.

The scout ship takes a look and sends back the following startling message, "My God! Those vehicles were friendly!"

"Farfetched," you say. *Perhaps not.*

Target identification (TGT ID) always has been a subject of importance to the U. S. Army. Today it is gaining even greater significance. Due to the relatively short range of our antiarmor weapons in World War II and succeeding years, we already were under effective fire before we could fire. There was no doubt who the bad guys were. However, with the emergence of missile firing helicopters, TGT ID has become crucial. The 3,700-plus meters maximum range of our missile system allows us to engage the enemy well outside the

range of most of his organic weapons.

There's an axiom going around which says, in part, *if you can see it, you can kill it.* I would like to change that to: *if you can see it, and identify it, you can kill it.* We figure to be outnumbered in the next battle. Certainly we cannot afford to damage or destroy our own resources, or those of our allies, because we cannot quickly identify tactical vehicles on the battlefield. Targets often can be identified as enemy by directions of movement, orientation of gun tubes and overall actions. But, there will be situations on the fluid high threat battlefield when these identification aids will be rendered useless. Ability to identify these vehicles as friendly or enemy then becomes paramount.

Every aviator should be able to identify *every* combat vehicle that might appear on the battlefield. Then proper vehicles can be confidently and quickly taken under fire. Also, ID reports to the S-2 (intelligence) would allow him to build an accurate picture of exactly what type forces we're up against.

That's what this article is about—identification of armored fighting vehicles. I'm limiting this article to a discussion of the tank-type vehicles that you probably will see in great numbers on a near future battlefield.

What about IDing armor? Well, let me assure you that it's easy—*if you know what to look for.* All tanks have at least one unique feature which sets them apart from other tanks. Finding the distinctive feature(s) will enable you not only to identify a tank but also its type or model.

There are four areas of the armored vehicle to use in ID procedures: *the suspension system, the turret, the guns and the commander's cupola.*

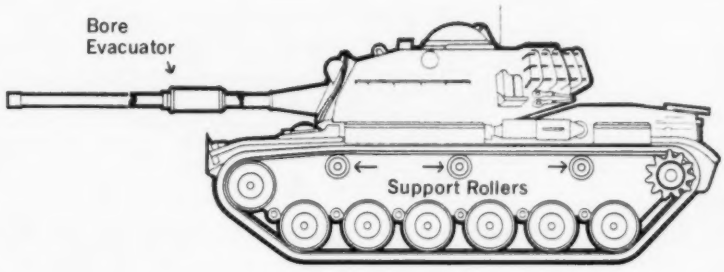


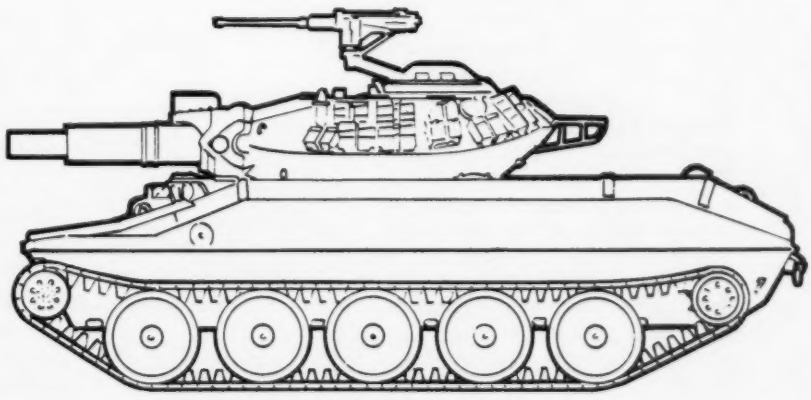
Figure 1 ⬆

Suspension system: Notice that the suspension system in figure 1 has road wheels and support rollers. This is known as a torsion bar suspension system. It is characteristic of most NATO (North Atlantic Treaty Organization) armored vehicles. This includes the American M-48, M-60A1 and A-2; the Swedish "S" tank; the German Leopard; the British Chieftain and Centurion; and both the French AMX-13 and AMX-30 armored vehicles. The Warsaw Pact vehicles which have the torsion bar suspension include the Soviet T-10; the old JS (Joseph Stalin) series heavy tanks and the new M-1970 (T-70) tank. But to ensure proper identification, the other three areas must be considered.

The only NATO tank-like vehicle which does not appear to have a torsion bar suspension system is the M-551 Sheridan. (I know it's an armored reconnaissance airborne assault vehicle, but it has a tank-like silhouette and a tank defeating capability—so we'll treat it as a tank.) You might confuse it as Warsaw Pact armor until you look at the remainder of the vehicle (figure 2). In addition, some NATO countries—Britain and France—use armor plating which partially covers and protects the suspension system (figure 3).

The suspension system of most Warsaw Pact vehicles does not contain support rollers. It is called a "Christie" suspension system (figure 4). This includes the T-34, PT-76, T-54, T-55 and T-62. The tanks that do not have the Christie

Figure 2 ⬇



system already have been mentioned.

So, for the most part, it's support rollers—NATO; no support rollers—Warsaw Pact. Fascinating, isn't it?

Turrets (low-armored, usually revolving, tower-like structure for a gun(s), gunner and crew): On the battlefield you probably will *not* see the suspension system first. It will be masked by terrain, smoke, dust and vegetation. So, let's look at a second area of interest—the turret.

Observing the shape, size and location of the turret in relation to the hull of the vehicle will aid you to identify the type of vehicle. The T-34 has a small, box-like turret located well forward on the hull (figure 5). Other Warsaw Pact vehicles have well-sloped hemispherical, well-rounded, low-silhouetted turrets located slightly forward of center (figure 6). The turret of the AMX-13 is located well to the rear (figure 7). The turret of the M-60 comes to a point. The Swedish "S" doesn't even have a turret (figure 8.) In addition you will notice that all of the allied armored vehicles have counter balanced turrets. That is, there is a space between the rear portion of the turret and the vehicle hull (turret overhang). The Soviet T-10 (M) is the only Warsaw Pact tank with turret overhang. As you can readily see, the turret plays an important part in target ID.

Guns: If you study main guns well enough, that's all you have to see in order to ID NATO or Warsaw Pact vehicles. If the gun tube possesses a bore evacuator, blast deflector, or muzzle brake, its location on the tube will, in most instances, readily identify the vehicle (see figures 9 and 10).

The bore evacuator is located in the first one-third of the gun tube on most NATO vehicles (figure 1). This includes the new M-48A5; the M-60 series; German Leopard; Swedish "S" and British Centurion. The outgoing M-48A3 and the British Chieftain have bore evacuators located in the last one-third of the gun tubes near the muzzle (figure 3).

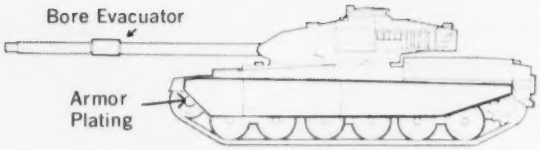


Figure 3

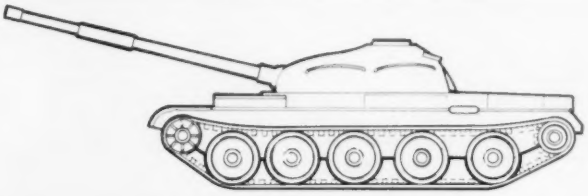


Figure 4

All Warsaw Pact armored vehicles have the bore evacuator located in the last one-third of the gun tube (figure 6).

Only two NATO vehicles have anything on the muzzle end of the tube. They are the AMX-13 with a muzzle brake (figure 7) and the M-48A3 which has a blast deflector. The characteristic shape of the AMX-13 will preclude its being mistaken for a Warsaw Pact vehicle—and we already have discussed ID characteristics of the M-48A3.

All other armored vehicles which have anything on the muzzle end are Warsaw Pact.

Only two vehicles don't have anything at all on the gun tube, the ancient Soviet T-34 (figure 5)

Figure 5

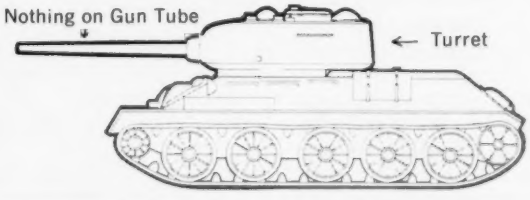
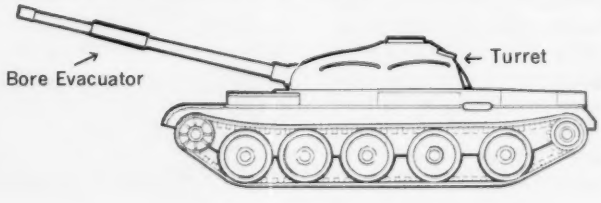


Figure 6



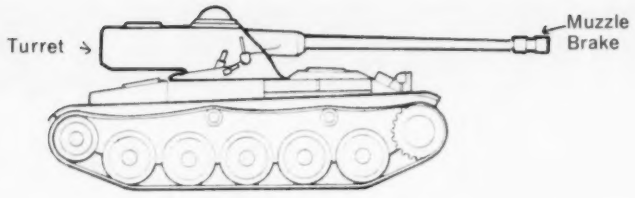


Figure 7

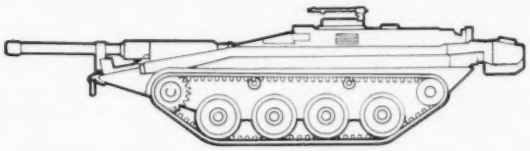


Figure 8

Bore Evacuator
A short thick tube-like device located on the main gun tube which permits all gases to escape from the bore when the gun is fired

Blast Deflector
A "T" shaped device located on the end of the main gun tube which channels the blast and smoke from firing to the sides of the vehicle enabling the tank commander and gunner to observe the strike of the round

Muzzle Brake
A device attached to the muzzle of the main gun which utilizes escaping gases to reduce recoil of the weapon system

Figure 9

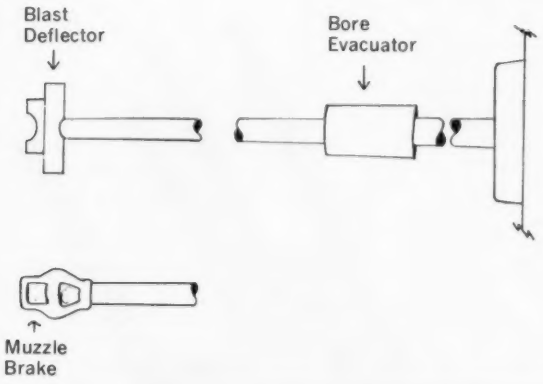
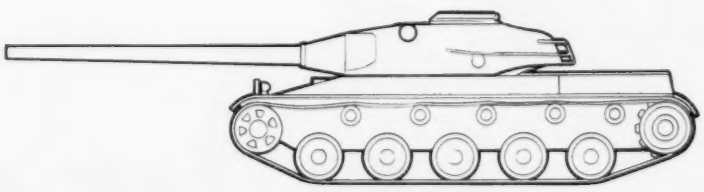


Figure 10

Figure 11



and the French AMX-30 (figure 11).

Cupolas: This one is easy. Most NATO vehicles have cupolas, with the exception of the German Leopard and French AMX-13. A cupola basically is a smaller domed-shaped, armor-plated turret found on top of the main turret. It can be operated independently of the main turret and houses or supports a tank commander's machinegun. There are other features to identify these tanks. They both have torsion bar suspension systems. The Leopard also has a bore evacuator in the first one-third of the gun tubes (NATO characteristics). The AMX-13 has its characteristic shape with the turret well to the rear on the hull.

For identification purposes we can say that no Warsaw Pact vehicles have cupolas—only extremely low rotating hatches. They are made too low to be seen from any distance.

Here's hoping that I've whetted your appetite for target ID. In a future issue we will talk about as-

uns, reconnaissance vehicles

nored personnel carriers.

SELF-PROPELLED

THE

This is a translation of an article on the ZSU-23-4
which appeared in the July 1975 issue
of the Soviet military magazine *Xnamenosis*. It is considered
the most comprehensive description of
the ZSU-23-4 published to date in the open press

Engineer-Lieutenant Colonel V. Strelkov

ANTIAIRCRAFT GUN

ZSU-23-4

ANTIAIRCRAFT machineguns and artillery systems capable of hitting air targets became operational as early as World War I. At first, Maxim type machineguns and field guns were adapted for this application. They were placed on special mounts which rotated easily in azimuth and which could fire at high angles of elevation. During the course of the war the Putilov Plant model 1914 3-inch truck-mounted antiaircraft gun became operational. This weapon signaled the beginning of the development of Russian antiaircraft artillery.

The *DIGEST* Thanks
The Foreign Science and Technology Center
Charlottesville, VA
For This Article

Improvement in aircraft was accompanied by improvement in antiaircraft artillery. At the end of the thirties, 76 mm and 85 mm antiaircraft guns became operational in the Red Army. Automatic guns also were developed—25 mm and 37 mm automatic antiaircraft guns. Antiaircraft artillery became capable of effectively engaging new types of enemy aircraft. For example, during the Great Patriotic War [World War II], antiaircraft gun and machinegun fire downed more than 3,000 German airplanes.

Development of antiaircraft defensive weapons proceeded even more rapidly in the postwar years. Missile, artillery and machinegun systems were developed, each of which performs a specific range of missions. One such system is the ZSU-23-4, 23 mm quad-mount self-propelled antiaircraft gun, which is capable of delivering fire on air targets while moving with troop combat formations. Its missions include defending fixed installations, combat formations or enroute columns from hostile aircraft at altitudes up to 1,500 meters. This weapon can also be used against ground targets. Its range of effective fire is 2,500 meters.

This weapon's firepower is based on the AZP-23 mm quad-mount automatic antiaircraft gun. It is mounted on the front part of a rotating turret and is capable of rapid fire (3,400 rounds per minute). This makes it possible to establish the requisite density of projectiles in the vicinity of the target and to bring the target down. As a rule, fire is delivered in short bursts of 3 to 5 or 5 to 10 rounds per barrel and up to 50 rounds per barrel at high-speed targets.

The gun is positioned by a power drive system, with a range of elevation angles from -4 degrees to 85 degrees, with gun azimuth positioning effected by rotating the turret. The standard ammunition load is 2,000 rounds. Ammunition boxes containing link belts are located in the forward lateral turret bays. [Ordnance] fired includes fragmentation/high-explosive/incendiary/tracer [rounds] and [also] armor-piercing/incendiary/tracer rounds. The belts are made up in a specified sequence, usually three fragmentation/high-explosive/incendiary/tracer rounds [and then] one armor-piercing/incendiary/tracer round, etc.

The vehicle is operated by a four-man crew: commander, scan radar operator/gunner, range operator and driver. The first three are stationed in the rotating turret, while the driver's station is in the forward section of the armored hull.

Gun control, gun shift from traveling position to firing position and back, as well as firing are handled directly from the commander's station or from the scan radar operator/gunner's station.

In order to ensure safety during delivery of fire, the crew is separated from the gun by a vertical armor bulkhead which provides protection from bullets and shell fragments, as well as from penetration by propellant gases and flame. In addition, a special blocking device prevents the gun from being fired when the driver's hatch is open.

During live firing, gun positioning can be effected automatically, from the radar fire control system, or manually, with hand wheels. Radar-operated automatic fire control is the principal system used on air targets—the system containing the following: radar, sighting device, computer, and line-of-sighting and line-of-elevation stabilization units.

The radar performs search, detection, automatic tracking and determination of target range and angular position. The radar equipment and control panels are located in the turret instrument bay in front of the scan operator/gunner and range operator. The antenna rests on a special mount above the turret. The antenna is a parabolic reflector, covered by a radio wave-passing screen, with a horn-type exciter, displaced relative to the optical axis. When the exciter rotates, a three-dimensional directional pattern with equisignal zone is formed. This makes it possible to implement the principle of automatic tracking with comparatively simple devices. If the target displaces from the equisignal direction, an error signal will appear in the system and servodrives will adjust the antenna direction.

The sighting device makes it possible to track a target by angular position under optical visibility conditions, with visual target observation during fire. It consists of a left element, mechanically linked to the radar antenna, and a right element, coinciding in direction with the gun barrels.

The computer solves projectile-target intercept problems, or more precisely determines lead angles when aiming the guns at a moving target. Input data are the target coordinates determined with the aid of radar or gunsight.

The line-of-sighting and line-of-elevation stabilization units and elements include an azimuth gyro horizon, a line-of-sighting and line-of-elevation stabilization systems,

with gunsight and gun coordinate converters respectively.

The stabilization system holds the specified radar antenna and gun pointing angle as the vehicle pitches and rolls. This is essential in order to maintain target tracking with radar or gunsight and to deliver aimed fire. The sensing element in the system is the azimuth gyro horizon which measures the vehicle's angular deviation from the specified position and which alters antenna and gun position relative to the vehicle hull through servo-systems. A kinematic roll circuit is provided to prevent change in antenna and azimuth gyro horizon angle during turret rotation; when the turret turns, this circuit turns the antenna and azimuth gyro horizon by the same angle, but in the opposite direction.

The stabilizing system principle of operation can be shown with a simple example. Imagine that you are seated in a rocking boat observing a passing ship through a camera lens and endeavoring to hold the object in view. You involuntarily react to the boat's rolling and pitching by changing the camera angle. If the boat turns, you must turn the camera to keep the ship in the field of view. The stabilization system and kinematic roll circuit, in which the azimuth gyro horizon is the "sensory organ," solve the problem in an analogous manner.

All antiaircraft gun systems are mounted on an armored tracked vehicle, which ensures a high speed of travel, maneuverability and good off-road capability. It consists of three compartments: the forward, driver's compartment; the middle, gun compartment; and the rear, engine compartment. The forward compartment contains the driver's seat, controls, gauges and primary electric power system. The fighting compartment contains the turret and all systems. The engine compartment contains a 280-horsepower V-6R 4-cycle diesel engine

and auxiliary systems, as well as power generating units (DG4M-1 gas turbine), plus DC [direct current] and AC [alternating current] generators.

For continuous monitoring of the tank's position and travel, the vehicle contains tank navigation equipment, which enables the commander and driver to obtain terrain orientation and to lay out the vehicle's course on a map without emerging from the vehicle.

Day and night vision devices give the crew the capability of operating day or night. They provide a fairly good field of view. Mounted in the turret are daylight observation periscopes (TPKU-2) and two lateral viewing instruments (BM-190); the TPKU-2 has a vertical control mechanism with which the viewing angle can be changed within certain limits. During hours of darkness, the TPKU-2 is replaced with TKN-1T infrared electron-optical periscopic night vision instrument, which has a visibility range of 200 to 250 meters.

For daylight road observation, the driver has a BM-130 periscope and two lateral direct observation instruments with glass blocks in the side plates right and left. During hours of darkness a TVN-2 is mounted in place of the BM-190 in the dome over the driver. Two FG-125 infrared light elements are employed.

Intercommunications between crewmembers are handled through the tank intercom system, while communications with the outside are effected with a R-123 radio set from the commander's and gunner's station. Each crewmember has a helmet with built-in earphones and a throat microphone.

During combat the search operator/gunner and range operator spot a target on surveillance mode or sector scan independently and on external target designation. After a target has been spotted and identified, they switch the radar to automatic tracking mode. Target coordinates are fed into the computer for determining gun lead angle. The commander or scan operator/gunner opens fire on the signal, "we have data" on the computer.

In like manner, delivery of fire can also be effected during target tracking by angular position with the aid of the gunsight. In this case the radar determines only range to target.

In addition, delivery of fire may be effected with utilization of a backup gunsight when the scan operator/gunner feeds in a lead angle determined on the basis of target aspect rings. This mode is used in a complex combat situation when the radar, computer or stabilization system have been put out of commission.

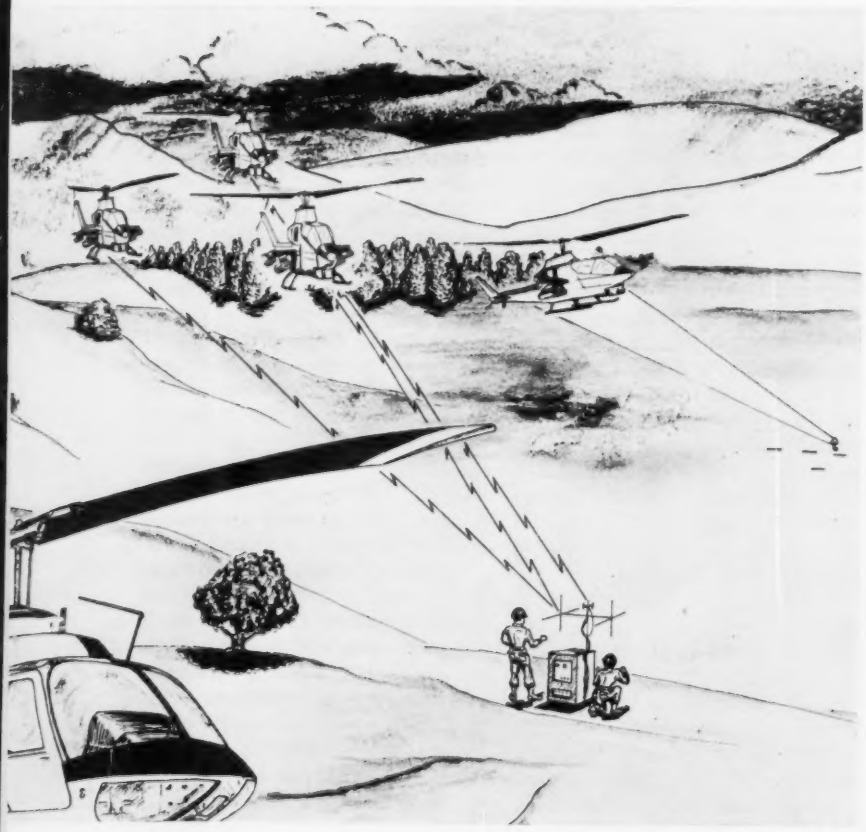
The ZSU-23-4 possesses a certain degree of resistance to the damage effects of nuclear weapons. It is outfitted with antinuclear protection and firefighting equipment. Radioactive dust is removed from the air entering the vehicle by a special filtration/ventilation unit. It establishes a higher pressure inside the vehicle, which prevents contaminated outside air from entering through cracks.

The ZSU-23-4 is an effective means of engaging hostile aircraft.

Air Traffic Management and Tactical Instruments

Captain Lewis D. Ray

Project Officer
Deputy For Combat Developments
U. S. Army Aviation Center



TACTICAL INSTRUMENT flying is a giant step toward the capability for around-the-clock operations on the modern high threat battlefield. But with the fluid battle situations and the rapidly changing tactical situation, who will control and coordinate the air traffic? Who will provide flight following and clearances into tactical instrument conditions? How does an aviator fly tactical instruments in an electronic warfare environment or when radio silence is necessary?

Answers to questions such as these are evasive. However, concepts exist that attempt to deal with these very problems. This article discusses some ideas and concepts about managing air traffic in the tactical instrument environment.

Army doctrine in the revised FM 1-60, "Army Air Traffic Management in the Combat Zone" (recently published by Department of the Army), provides for a system of flight operations centers (FOCs) at the corps level, flight coordination centers (FCCs) at corps and division, and approach/departure control facilities, airfield control towers and navigational aids (NAVAIDs) at subordinate echelon locations throughout the corps area for the control of Army air traffic.

Contact between the division

This, the fifth in a series of seven articles concerning tactical instruments, reviews concepts of clearances and flight following. The story centers on coordination and communication for instrument flight enroute to, in and from the battle area

FCC and aircraft in the forward areas can be maintained by use of radio or landline communications. When radio communication is not feasible or desirable, communication for flight clearances and information can be obtained by landline using the facilities of forward tactical units.

The division FCC is responsible for providing enroute flight following service for Army aircraft in forward areas. When terrain flying requirements make communications between FCC and the aircraft impossible, then the FCC must provide remote flight following and relay teams at forward locations as needed.

Additionally, current Army doctrine employs mobile teams, provided by the division FCC, to operate throughout the division and brigade areas to extend the communication and flight following capability of the FCC by relaying flight following information and flight clearances. Tactical instrument flight in the forward area depends heavily on these mobile units to emplace and operate navigational aids on request. The teams could best be collocated at or with the brigade and divarty (division artillery) aviation sections and share their existing communication networks when possible.

Using their own organic vehicles and equipment, the mobile teams can affect coordination for tactical instrument flights from either rear areas enroute to forward locations or forward areas to rear terminals. Upon request, they could pre-position portable radio beacons such as the AN/TRN-30 (which will be fielded in the near future) and operate them only when requested in order to reduce potential enemy electronic detection.

When available, Army pathfinder units could provide navigational assistance and aircraft control services during sustained employment of Army aircraft in forward, unprepared locations. Pathfinders can select, improve, mark and control landing/pickup/drop zones. They also may operate at forward helipads.

The pathfinder facility could maintain communications with aircraft and fire support units as necessary for control and coordination in the landing/pickup/drop zone area. Close coordination with mobile FCC team elements will enhance pathfinder effectiveness and extend tactical instrument flight capabilities to any unimproved terminal location.

O.K., now you know the framework of the system, but how do you operate within it? Who do you call and how do you coordinate a tactical instrument flight?

First, plan your tactical instrument flight remembering to consider special mission requirements, the threat, frequencies and call signs, and current weather information. Particular attention should be placed on map study in order to select the route and altitude that both contribute to mission accomplishment, yet avoid the threat.

Select the route which affords maximum concealment and masking from the air defense threat. Pick an altitude that stays below the air defense threat, yet provides safe obstacle clearance (400 feet above the highest obstacle is a recommended safe enroute altitude).

Next, determine and coordinate early any NAVAID requirements needed in forward areas. Also, coordinate the flight clearance if possible. In the absence of an air traffic control facility, you will have to plan to be your own clearance authority and arrange for flight following with other aviation or ground tactical units along the route. Early coordination will ensure maximum reaction time by supporting NAVAIDs elements in the forward areas.

In the absence of a standard, published enroute and approach diagram, you can determine a safe enroute and letdown altitude by carefully studying the map. A recommended enroute and minimum descent altitude of 400 feet above the highest obstacle should provide an adequate safety buffer zone.

Don't forget to allow for refueling and rearming stops when planning your flight and coordinating for NAVAIDs.

Of course, when flying from a rear controlled area to a forward uncontrolled area, you can maintain contact with the FCC flight following facility as long as possible. When contact can no longer be maintained, then you will have to assume responsibility for making contact with other tactical forward units for flight following. However, when flying from an uncontrolled forward area to controlled airspace in the rear, the aviator must serve as his own initial clearance authority and attempt to make contact with rear area FCC elements enroute. Until contact is made, you should closely follow the previously planned and coordinated flight plan.

Flight in a severe electronic warfare (EW) threat or radio silence environment poses special problems

Continued on page 26

the "REAL CAV"

MSG Wayne E. Hair

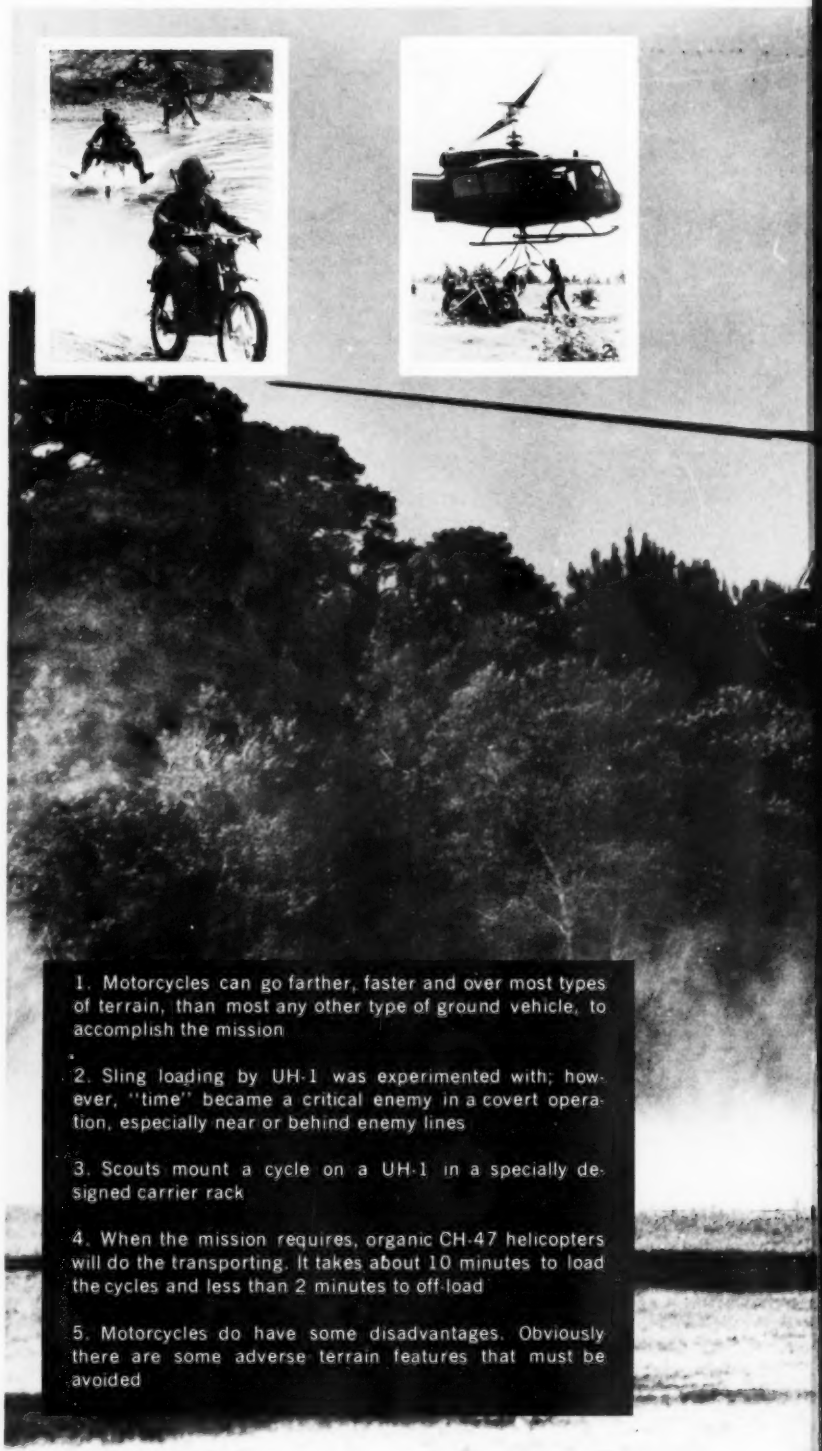
Information Supervisor
6th Cavalry Brigade
(Air Combat)
Fort Hood, TX

THE 6TH CAVALRY Brigade (Air Combat) at Fort Hood, TX, has the mission of "finding and destroying enemy tanks." For the "finding" part of the mission, the brigade is authorized an air cavalry squadron. Known as the "Real Cav," the 4th Squadron, 9th Cavalry, employs every innovative means possible to locate and gather information about enemy movement and operations.

Within the three authorized air cavalry troops, there is a reconnaissance platoon of 36 scouts (MOS 11D). If the area of interest is small and time is not a factor, the scouts will probably be inserted by helicopter and then do the leg exercise. However, if the tactical situation and terrain allow; the area of operation is large; and time is critical, there is a solution —the motorcycle.

The 6th Cav's cycles are lightweight, fast, easy to maintain and operate, and have outstanding gas mileage. These machines can be loaded, three per sortie, internally in the UH-1 Huey or two per sortie externally in specially designed carrier racks. For larger operations, a CH-47 Chinook from the support squadron can be employed.

For that extended reconnaissance range, the scout and his motorcycle has added a new dimension to the "finding" part of the 6th Cavalry Brigade's tank-killing mission.



1. Motorcycles can go farther, faster and over most types of terrain, than most any other type of ground vehicle, to accomplish the mission

2. Sling loading by UH-1 was experimented with; however, "time" became a critical enemy in a covert operation, especially near or behind enemy lines

3. Scouts mount a cycle on a UH-1 in a specially designed carrier rack

4. When the mission requires, organic CH-47 helicopters will do the transporting. It takes about 10 minutes to load the cycles and less than 2 minutes to off-load

5. Motorcycles do have some disadvantages. Obviously there are some adverse terrain features that must be avoided

3.

4.

ATM and Tac Instruments

Continued from page 23

to tactical instrument flight. Of necessity, much of tactical flight will be conducted in a severe EW threat environment. And, to avoid electronic detection in forward areas, NAVAIDs will have to be restricted to operation only when they are to be used, and then, only intermittently. In order to avoid detection and destruction, the electronic signature of navigational aids and aircraft must be kept to a minimum, thereby making radio silence a requisite for mission accomplishment.

It will be necessary for an aviator to use landline communications when available for coordinating and clearing tactical instrument flights with an FCC element prior to takeoff. If landline communication is not possible, you can use secure radio channels. Close initial coordination with the FCC element is more important in this environment prior to initiating the flight in order to eliminate unnecessary radio communications during flight.

During a radio silence environment, voice radio communication for navigation and flight following is not possible. Again, coordination in detail prior to takeoff is imperative, or you must serve as your own clearance authority during inflight transitions from VFR (visual flight rules) to tactical instrument flight, often operating without a flight following facility or unit while enroute.

As an example, let's pose three typical missions you could expect to fly in a high threat environment. These missions represent a possible way to fly the missions and are intended only to serve as an idea of *how* to do it. You may be able to think of better ways to improve these procedures.

Example 1: You must fly a utility helicopter from the corps rear area to a forward brigade location. You plan the flight using the unit SOP (standing operating procedure) as a checklist. Next, you determine routes, minimum flight altitudes and navigational aids requirements. Coordination with the corps area FOC/FCC is effected to ensure flight following, and navigational aids are emplaced and operational in forward areas when they are needed. The flight clearance is received and you depart the basefield.

Enroute, your aircraft is kept under both communications and radar flight following contact. As you progress forward, it is necessary to transition to a lower flight altitude in order to avoid enemy air defense detection and destruction. Radar contact is terminated but voice communication is maintained by the division FCC.

Moving farther toward the front, descent to the minimum enroute altitude (MEA) (previously determined from map study) in order to remain below the air defense threat is necessary. Contact is lost with the division FCC element. Consequently, you establish contact with the forward brigade aviation section for flight following. You request and obtain weather conditions in the area and direct that the NAVAID there be turned on.

After tracking inbound and arriving at the brigade location, you initiate the preplanned approach to the portable nondirectional beacon (NDB). During descent to the minimum descent altitude (MDA), you break out of the low clouds and visually make the landing.

Example 2: You are the pilot of an observation helicopter assigned to an air cavalry troop operating near the FEBA (forward edge of the battle area). You have been directed to fly the aircraft from your location to the corps rear to a support maintenance facility.

By conducting a thorough map reconnaissance you select the route and determine the minimum enroute altitude. Contact with an FCC element cannot be made prior to takeoff but communications with the forward supported brigade confirm the location and operation of an enroute navigational beacon at the brigade aviation section location. The flight route is modified to use this beacon.

After executing an instrument takeoff into IFR (instrument flight rules) conditions, you fly at the minimum safe altitude that ensures terrain and obstacle clearance, yet minimizes the possibility of enemy air defense weapon detection. Early attempts to establish contact with an FCC element are not successful, but contact with the brigade aviation section is maintained and relayed to the FCC by landline from the brigade aviation section.

As you proceed farther toward the rear area, a higher altitude is continually selected to widen the safety margin above the terrain. Contact is established with the division FCC and subsequent radar contact is made. Flight following and routing information is transmitted to the aircraft by the FCC to ensure traffic separation.

At or near the division rear boundary, the observation aircraft is handed off to the corps FOC/FCC for flight following to the termination point. At the termination airfield, a GCA (ground controlled approach) may be initiated if visual conditions are not encountered.

Example 3: In order to provide timely attack helicopter firepower in defense of the forward battle area, you must return to the forward area refueling and rearming point (FARRP) to refuel and rearm. Because of deteriorating visibility conditions, reliance on tactical instrument flight is necessary

since the FARRP location is rapidly being enveloped with a low cloud layer. The situation makes it necessary to conduct a thorough map reconnaissance while in the air to determine minimum enroute altitudes and minimum descent altitudes at the FARRP location.

Since no flight coordination facility is located in the vicinity, you have to clear yourself into IFR conditions in order to return to the FARRP. Radio contact with the FARRP is made and a portable NDB is operational there. You fly into the poor visibility conditions using tactical instrument flight. Flight following and monitoring enroute is maintained by both the unit and the FARRP personnel. Upon arrival over the NDB, you initiate a spiraling approach by turning at a standard rate and simultaneously descending at 200 to 300 feet per minute until you reach the predetermined minimum descent altitude (approximately 200 feet above the highest obstacle (AHO) within 3,000 meters of the landing point). During the descending turn, you break out of the clouds within sight of the fuel and ammunition supply point.

After refueling and rearming, you return to the forward battle area by flying outbound from the NDB located at the FARRP. After returning to visual flight conditions, use terrain flying to return to attack positions to continue the battle.

This concept of air traffic control during tactical instrument flight should be used and further refined in order to develop the best possible procedure to coordinate and flight follow the tactical instrument flight. The examples are provided merely as sample missions. ***You may have some better ideas on how it ought to work. If so, put them to work and let us hear from you. Write to Editor, U.S. ARMY AVIATION DIGEST, P.O. Drawer P, Fort Rucker, AL 36362.***

Continued from page 5

tend to regard guns and scouts, which are organized in different platoons, as interchangeable. They are not completely. The scout pilot doesn't fly his airplane, ***he wears it if he is to be successful.*** The gun pilot has to know by feel the moves that a particular scout will make when he comes under fire or is in trouble. Otherwise he may lose an extra five to ten seconds in placing fire to cover the scout's break. That delay can be deadly. Only continual association will bring those two to working as a team.

The question of whether to use one or two guns to cover the scout depends on the tactical situation. In a high threat area, whether flying at altitude or NOE, the second gun is vital so that attack directions can be varied, extra antiaircraft weapons engaged, etc. In my experience, the close teamwork of the lead gun with the scout is not as essential for the second gun which can be much more interchangeable than the lead man.

The last element of the team is the slick carrying the infantry, or now the 11Ds. To me this has always been a very key requirement and our shortage of this element in the old UTT days was a distinct disadvantage. I believe, however, that the dismount element that is following the team does not need to be, under most circumstances, a platoon or even an eleven-man squad, but rather a five-man fire team. If you wish to put more people on the ground than about twenty, I believe it is better to go to a supporting infantry company, which has greater staying power and is designed for ground combat, rather than tying your reconnaissance agency to a long term commitment in a restricted area, the inevitable result when the recon agency starts committing large numbers of people in the dismounted role. Incidentally, the scouts or infantrymen that ride that trail bird should wear Nomex. They burn just as badly when their bird goes down in flames as the aircrew does and they spend as much time exposed in the forward area.

The above has indicated some thoughts on reorganizing the current air cavalry troop, but I would like to add a couple more. I have drawn these additional points largely from a detailed study made by a group of air cavalry captains when the 101st Airborne was closing out. This study group was charged with determining how the capability of the air cav troop could be increased while holding to essentially the current manpower authorization. In addition to the thoughts that I have included in the above, they provided the following:

- Increase the number of Cobras to twelve while reducing the number of scout birds. This provides a better maintenance schedule for the Cobra, the limiting factor, and using single scouts as we have described does not require the present number of scout aircraft.
- Place in every troop a five-man sheet metal team so that birds which get holed today can get repaired tonight for use tomorrow. (We will probably not have the luxury of floats next time.)
- Put in QC men for avionics and armaments.
- Pay for these minor increases in maintenance personnel by reducing the air rifle platoon to twenty-five.
- Have all incoming pilots be qualified either in the Cobra or in the scout since these are the two most critical elements of the reconnaissance team. (I would note that in any theater of operations, after you get qualified 58 pilots, only a portion of them will turn out to be scouts, since this takes a particular combination, which not every man has, of eyes, feel and guts, leavened with experience in the AO.)

The study group felt that with these changes, whereas we produced under our current organization from 1,400 to 2,600 flight hours per troop per month under battle conditions, we could run the production to 3,000 hours for no increase in personnel. This report was made part of the final report of the 101st Airborne Division and sent separately to both MASSTER and ACSFOR.

I would like to add for a moment some comments on the battle of Kontum, where the people who were flying for me first introduced the TOW to combat. [See "1st Combat Aerial Tow Team; Helicopter vs Armor," Feb. 1974, ***DIGEST***.] First of all, our effort in that battle was built around two air cav troops, one of which worked the Kontum area every day and the other which worked the Bong Son Plain, the area west of Pleiku, and Kontum, shifting in accordance with the situation. With this very small force, reinforced by a separate gun company and two TOW birds, we were effective in screening Pleiku, delaying in Bong Son, and detecting and blunting the enemy's main attack at Kontum, a good combination of cavalry in both the reconnaissance and economy of force roles.

Due to our air superiority and the effectiveness of

Refer to Acronym Key on page 5

the air cavalry, the NVA made great efforts to conceal his armored force, which was his strong right hand punch for this battle, striking fear into the defenders as great as that in France in 1940. His efforts at concealment involved hiding his tanks in dense jungle during daylight hours and attacking during the hours of darkness. The cavalry troops during daylight were able to detect his shifting of this force from one side of Kontum to the other and thus pinpoint the direction of his next main attack. On one or two occasions we were able in fact to locate individual tanks during daylight hours and these were engaged and destroyed by the TOW which was called forward on a case-by-case basis to deal with the specific situation. The TOW in this case was mounted on B models, of which there were only two. Hence this force had to be very carefully used and operated at maximum range to avoid the ground fire.

In the attack on Kontum at the end of May, the NVA launched its attack at approximately 0400, penetrated an infantry regiment's position, and with tank-infantry teams started overrunning the reserve regiment. We responded from the airfields at Pleiku and at first light, 0600, had a command and control aircraft and a set of guns in the area. The guns engaged the tank-infantry force. Our people on the ground complained that the fire from the rockets was too close and hitting among them. But when it was pointed out that the alternative was to be overrun, they agreed to successive runs. On these runs, fire was held to the turret so it could be more accurately placed. This fire, however, was sufficient to drive to cover the infantry elements of the tank-infantry teams. The tankers, in turn, being concerned about penetrating built-up areas in the city without infantry support, stopped to regroup. Successive runs by the Cobras delayed the regrouping and suppressed 12.7 machineguns that were accompanying the force. The TOWs, lumbering up on the B models, arrived approximately 0625 and in the next hour destroyed the tanks of the entire attacking force. By 0730 the battle had been decided, although there was considerable mopping up remaining to be done by the infantry on the ground, and this took days.

While the forces engaged here were quite small—two cav troops, one gun company, two TOW birds—I think it shows a microcosm of the air cavalry combat brigade organization, an economy of force unit, a reconnaissance unit, and finally a heavy fire support unit at the crucial moment.

One last thought—the role of the cavalry commander. It's my view that when we are talking about the reconnaissance officer—whether scout platoon leader of the battalion, the corps cavalry regiment commander or any reconnaissance commander in between—that there must be a direct and personal relationship between the force commander and his reconnaissance officer. As force commander, I placed a great deal of emphasis on knowing what particular scout pilot made a report. It was, for example, quite critical to me whether I had a report of negative activity from one of my old hands or from someone less attuned to the situation. Beyond knowing the reactions of my individual scouts, I consider it critical to have the judgment of my reconnaissance commander as to what the situation is. I rely very heavily on his judgment and his feel in developing my own feel for the battle, and I think this is imperative. If the commander and the reconnaissance officer are unable to develop this coordination, it is a very unhappy marriage and you had better seek a divorce.

Jimmy, that's a quick summary of my thoughts on the air cav business. Overall I believe it to be the most challenging and rewarding job in the Army. I envy you and wish you well.

Sincerely,

Major General John G. Hill Jr.
Deputy Commanding General
III Corps and Fort Hood

"...rapid fire power delivered when the scout comes under fire cannot be overemphasized."

Lieutenant General John J. Tolson

ARMY AVIATION HALL OF FAME

LIEUTENANT GENERAL John J. Tolson, as a colonel, became involved with Army aviation in 1953 while serving as Chief, Doctrine and Combat Development, G-3, Headquarters, Department of the Army. In this capacity, he initiated the first study dealing with the tactical application of air cavalry. As the Director of the Airborne/Army Aviation Department, Infantry School, he developed the first doctrine and wrote the first field manual governing the tactical employment of Army transport aviation on the battlefield. This work was validated in the Republic of Vietnam and remains the basic reference for the tactical employment of Army aviation.

Colonel Tolson was rated an Army aviator in 1957. In the early 1960s he served as the Director of Army Aviation as a brigadier general, and from 1965 to 1967 as a major general he commanded the U.S. Army Aviation School and Center. These years witnessed the explosive growth of aviation personnel, doctrine, technology, materiel and training.

After a tour in Vietnam as Commanding General, 1st Cavalry Division (Airmobile), he continued to exert significant positive influence on the further development of Army aviation. He placed heavy emphasis on worldwide aviation standardization and training, while serving successively as Commanding General, XVIII Airborne Corps and as Deputy Commanding General, United States Continental Army Command.

He retired from active military service as a Lieutenant General and Master Army Aviator in 1973.

Left—COL John J. Tolson when he was Assistant Commandant, Army Aviation School, Fort Rucker

Right—LTG John J. Tolson receives his Master Aviator Wings from General Ralph E. Haines Jr.

STANDARDIZATION CORNER

In a continuing effort to refine and improve the Aviation Standardization Program, several projects are underway to improve publications which regulate and support that program. This is a report on the general scope and progress of those projects. We'll give you a more detailed report as the publications receive final approval at Headquarters, Department of the Army (DA).

Army Regulations

The two primary aviation regulations—ARs 95-1 and 95-63 have been revised and are undergoing final review.

Perhaps the most significant change to AR 95-1 is a revised Combat Readiness Flying Program. The new program is more comprehensive and is designed to minimize the practice of "boring holes" and to place more emphasis on night and tactical flying. Additionally aviators with less than 1,500 hours serving in nonaviation assignments are no longer required to participate in the program. Other changes to the regulation are the inclusion of DA policy and guidance on touchdown autorotation training and utilization requirements for Simulated Flight Training Systems (SFTS).

AR 95-63 has a new title—"U.S. Army Aviation Readiness/Standardization Program." It has been revised and expanded to more clearly communicate DA policy and guidance concerning the role of standardization in achieving and maintaining not only aviator/crew, but also unit operational readiness. The proposed revision also eliminates the requirement to log 60 hours annually to retain IP/SIP (instructor pilot/standardization instructor pilot) status.

Operator's Manuals

Operator's manuals (dash 10s) are taking on a new look. The dash 10s will contain nine chapters instead of 14 and are designed to improve organization, readability and standardization. For instance: In the current manuals information on an oil system may be found in four different places throughout the manual. Under the new format all this information will be consolidated in one section. Also weight and balance computation and aircraft loading will be consolidated into one chapter.

Performance charts have been redesigned and standardized and will appear in the new manuals. We saw examples of these charts in the 1975 annual writ.

Also worth noting is a new feature being incorporated into aircrew checklists (dash 10 CLs). All immediate action checks will be underlined in the Emergency Procedures section. This is to emphasize those actions aviators are required to memorize.

The first manual to be published is the T-42 Cochise, which should be out by the time you read this. The remainder will be published and distributed periodically throughout the year.

Training Circulars

A new series of Training Circulars (TCs) is being developed to complement TC 1-34, "Qualification Training in Army Aircraft." Each TC in this series will prescribe standard procedures for aviator qualification, training and evaluation in a particular aircraft.

Annual Written Examination

Although the annual writ isn't a "publication" as described above, there are changes anticipated for the 1976 exam that deserve reporting here. As you may well know, the exam testing period beginning this year will be July to September. This change was made to bring the testing period in line with the new fiscal year dates and Form 759 closeouts. Significant changes in content also are being planned. Look for questions dealing with terrain flying tactical instrument procedures, night flying and other techniques of employing aviation in a high threat environment. Although these questions will be based only on *approved* Army doctrine, the supporting publications may not be distributed to the field prior to the testing period. In such cases pertinent extracts of the reference material will be reproduced and provided to you in the form of a Reference Data Book (RDB) in advance of testing time. This leads to an important point regarding this year's exam. *Time spent prior to the exam studying the RDB and accompanying Study Guide will be time well spent.*

That's our report. As noted before it has been general; hopefully it has been informative. We want to wrap up this month's "Corner" by encouraging you to let us know what subjects, or information, you would like discussed or reported in a future Standardization Corner. Write or call us at: Commander, U. S. Army Aviation Center, ATTN: ATZQ-S-P, Ft. Rucker, AL 36362. The AUTOVON is 558-6204/6487; the commerical number is area code 205, number 255-6204/6487.

William C. McDaniel
Directorate for Technical Research and Applications
U. S. Army Agency for Aviation Safety
USAAAVS

First in a series of four articles on

why pilots make errors

WHY DO PEOPLE do what they do? Why do pilots make errors? These questions are continually directed at psychologists and any others who may provide an answer. That psychology is a popular subject is evidenced by the many best-selling books on the market. Almost everyone has some idea about psychology and reasons for human behavior. Unfortunately, the layman's view of psychology and a psychologist's view of psychology may be worlds apart. This article and subsequent articles will attempt to bridge the gap between these worlds.

Psychologists are often amazed at almost glib classifications of people as "overconfident," "lacking ego strength," "excessive motivation to succeed," etc., etc., ad nauseum infinitum. It seems strange how people try to slip "abnormal" labels on fairly normal people, aviators in particular. Everyone gets all wrapped around their underwear trying to talk in "abnormal" terms.

The hard fact is that very few aviators fall into the "nut" or "crazy" classification. The number of catatonic schizophrenics in an aviation platoon ain't all that high. Probably no more than 10 percent squat in rigid, fixed positions in corners of rooms. Probably even fewer hang by one arm from the commander's light fixture for hours on end. The number of aviators concerned about the Martian's Electromagnetic Sterilization Ray is below the national average. Of course, if we have any of these people sitting or hanging around, we have a long complicated label to hang on them that explains their actions beautifully.

Psychology is becoming more concerned with what causes behavior and less concerned with labels or classifications. In the aviation field this is most appropriate. We should begin to move away from the "mental illness" concept (we don't have a heap of mentally ill) to specific behavioral problems (them, we got). This series of articles should give you some basic concepts about how to approach specific behavioral problems and provide a broader understanding of psychology as it applies to the aviation field. Hopefully, through these articles, the question will be changed from "Why does this happen?" to "What caused this behavior and how can it be changed?"

A Little History

Let's take a short trip through the history of psychology. The name psychology stems from a couple of Greek words, *psyche* meaning "the mind" and *logos* meaning "study." Thus, the word psychology means literally "the study of the mind." The study of the mind was going on long before the Greeks thought up the catchy title. The Egyptians created a little creature called a *ka*. The *ka* was a little fellow that was a person's exact duplicate living inside the person's head. The *ka* raised his right arm; the person raised his right arm. Seems silly, doesn't it? But, just how much have our ideas changed in the past 3,000 years?

We have renamed the Egyptian *ka* with more sophisticated terminology. Now, we speak of the "subconscious," "impulses," "egos," "mind," etc. We try to relate to other people in view of our own experiences. We become victims of our own logic. We advise, "You can do it if you just set your mind to it." We counsel, "Control your impulses." We rationalize, "Such weird actions must be caused by subconscious drives." Does all this make sense? Sure, unless you are the person receiving the advice, counseling or rationalizations. "Set my mind to it? What's he talking about? Control my impulses? What impulses? Subconscious drives? Stick it in your ear, fella!"

The idea of some underlying mental process con-

trolling behavior is a popular one indeed. Unfortunately, one cannot base a science on something so intangible. A psychologist by the name of John B. Watson recognized this in 1913. He stated quite simply that if psychology is ever destined to be considered a science, it must be based on observable events. We must be capable of telling other psychologists about these events and demonstrating them. Certainly we cannot do this with the mind or a mental process. We cannot measure the mind. We can't just pull out a mental process and demonstrate it like we would a gasoline engine.

Almost by default, psychology had to stop the classical "study of the mind" and look for something else. That something else turned out to be behavior. Behavior is often defined as the movement of an organism. We can observe movement or behavior and we can measure movement or behavior. We can observe how often a person takes a bath, how many times he scratches his head, how many times he activates the wrong control, and on and on.

This new approach to psychology, the science of behavior, in comparison with the other older concepts of psychology may appear dull and uninteresting. Much of this science appears to be mundane, plodding and repetitive. It lacks the glamour of the philosophy of the mind and the mystique commonly associated with "why we do what we do." Nevertheless, the scientific analysis of behavior has demonstrated some basic principles of behavior that are important to us as people, psychologists, pilots and ASOs. These principles cannot explain everything about behavior or people. There is still much we don't know, but they are useful tools allowing us to effectively work with people. Let's look at some of these principles.

What Affects Behavior

Having defined behavior as movement, what "things" affect this movement? "Things" seems like an odd term, but it isn't really. "Things" indicates objects or something we can see or hear. That's important. We must look at behavior in terms of observable things. In general, three things have an effect on behavior: environment, physical structure and the previous behavior of the organism. Let's take a closer look at these.

Environment. Those things that surround us comprise our environment. The same person may behave quite differently in a bar than he would in church. Observe the change in behavior in a room before and after the commander enters. Did the people change? Some people would prefer to say "the mood" has changed. Why? The behavior changed when the commander came into the room. This adequately describes what took place. By saying the mood has changed, do we add anything to this description? Not really. We only infer that our "mood" (whatever that may be) has changed and therefore everyone's "mood" must have done likewise. Adding this extra step (mood) only muddies the water. Changing the environment has an enormous effect on behavior. In future articles we will explore this effect and discuss how you can control some parts of the environment and bring about some "desired" behavior changes.

Physical state. Our physical structure determines much of our behavior. Unlike birds, men don't naturally fly. We require machines. Physiological variables have profound effects on behavior. By changing these variables, we can change behavior. Observe the person next to you in a bar after three or four quick shots. You can bet a measurable physiological change has taken place. What are the effects on behavior? Do you think your flying behavior might change after you've been in the cockpit for four straight hours?

Previous behavior. Typically, a person behaves in a manner very much like the way he behaved before in a similar situation. In different aircraft, pilots will tend to move controls the way they have learned even though now the controls are in different locations. How many times have you parked your car in the same general spot and then one day been forced to change locations? When you headed for the car at the end of the day, did you suddenly find yourself heading to the wrong place? A typical remark made at the point of observing your mistake is, "I must be losing my mind." Are you? Maybe, but psychologists would prefer to say you are simply reverting to a previously learned behavior.

To Sum Up

This article has given a general overview of principles of behavior. These principles of behavior have not attained the wide popularity that more traditional types of psychology have enjoyed.

We have looked at behavior from a scientific viewpoint. We have looked at three general things that affect behavior. Next month's article will begin to discuss in more detail what causes people to behave the way they do.

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HEALTH INDICATION TEST

THE HEALTH Indication Test (HIT) for gas turbine engines is a relatively simple method for accomplishing engine trend analysis in a field situation and prior to the aircraft being committed to flight. If the engine is in less than excellent condition when the base line is established, the HIT check will indicate only further deterioration. Therefore, every effort should be made to ensure that the engine is in excellent operating condition when base line data is established.

The following should be considered as requirements for establishing any base line data regardless of engine operating hours.

- Check for bleed air leaks at the hot air valve, bleed band, combustion chamber drain valve.
- Clean compressor.
- Foreign object damage inspection.
- Jet Cal and inspection of the exhaust gas temperature monitoring system.

Other considerations for establishing a new base line are when maintenance to the engine affects the gas flow path or exhaust gas temperature monitoring system, such as cleaning the engine, eliminating air leaks, hot end inspections, fuel control change, egt harness, and/or indicator change, etc.

If the HIT, following such maintenance, indicates a shift in base line temperature of greater than plus or minus 10° in egt/θ, then a new base line should be established. When developing the new base line, ensure that rpm and egt have stabilized. Three independent egt readings should be accomplished in the following manner: Ensure that rpm and egt are stable with the aircraft facing into the wind. Increase N_1 to proper value for the outside air temperature (OAT); record egt. Reduce N_1 to minimum and allow to stabilize for 30 seconds; increase to proper OAT and record egt. Repeat and average the value of the three readings.

Inability to obtain three readings within plus or minus 5°C. is generally indicative of a faulty egt system if accurate N_1 setting is accomplished. A variation of 20° or greater requires an entry on DA Form 2408-13. When the variation reaches 30° or more, the aircraft should be considered unsafe for flight.

When such a condition occurs, the HIT should be repeated. If the condition is still present, the troubleshooting steps in the applicable dash 20 technical manual for a condition of "high egt or TOT at steady state power" should be followed.

Experience has indicated that the large majority of egt increases can be ascribed to a dirty compressor, bleed air leaks, faulty egt or N_1 sensing systems, and other minor maintenance problems rather than internal engine problems requiring removal and overhaul.

It is desirable that standard procedures be established and required equipment be obtained, for such checks as the HIT program will initially result in an increase in this type of maintenance requirements.

A large change of temperature below base line usually indicates an egt system fault, engine maintenance, or an error in making the HIT. Erratic HIT variations greater than plus or minus 10° indicate an egt system fault or careless HIT settings and readings. A consistent low or high reading greater than 10° indicates improper setting of the base line and the base line egt's should be reestablished by the maintenance officer.

The HIT monitors only those portions of the engine exposed to or affected by the gas flow path. HIT supplements spectrographic oil analysis, engine vibration checks, topping checks, and other established engine maintenance procedures and is not intended to replace them.

The HIT is inherently safer than other monitoring systems of this type because it is accomplished on the ground or at low hover and should the test indicate a condition unacceptable for flight, the operator is aware of it before the aircraft is committed to flight.

All data required to perform the HIT is carried onboard the aircraft. Therefore, the pilot can accomplish a HIT check before each takeoff, if he so desires. As with any system that relies on instrument readings to establish base line data, the base line is only as good as the person taking the readings. Meticulous care and accurate readings when establishing an aircraft in the HIT program will provide constant and precise knowledge of engine condition and timely indication of deterioration before an unsafe condition develops.

A complete explanation of HIT procedures can also be found in the engine technical manual for the aircraft.

For further information, call USAAAVS, Environmental Factors / Fixed Wing Division, Ft. Rucker, AUTOVON 558-3913/3901.

CDR W. D. "Zip" Zirbel
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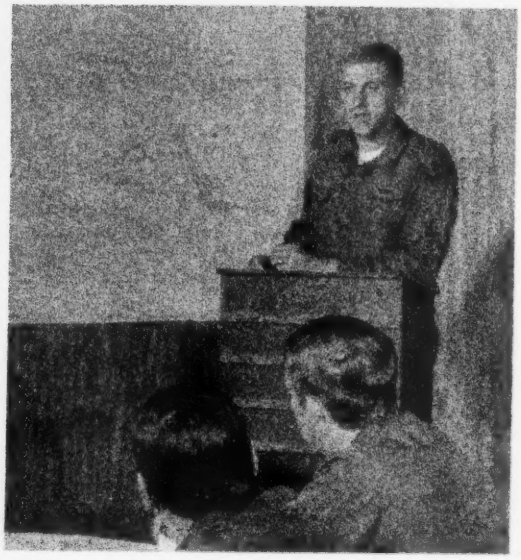
CHAOS INDEX



COULD YOU NAME the most accident prone throttle jock in your squadron? Whom do you think of? Vertigo Vic who is shaky on the ball at night or Casual Cal who thinks flight planning means he filed a DD 175? Both have characteristics that may elicit your suspicions, and yet they have survived to this point.

Every naval aviator has proven himself many times, and unless there is a change in the situational requirements or the individual, he will walk away from every landing. How can we recognize such a change? It could be an obvious fundamental difference such as his marriage breaking up, or we might observe a quantitative variation in his carrier landing performance. In either case, he might be considered a prime candidate for a pinky tonight and a little special counseling.

Suppose the same analysis is applied to the whole squadron. Let's accept that everyone is accident prone to some degree, and our objective is to keep the risk at an acceptable level. If there is reason to believe that we're becoming more accident prone, we would logically ask why and take corrective action. Don't wait for the accident board results to get our stuff together. Maybe that's like saying because the CO is a Sagittarius, tomorrow's a good day for a safety standdown. How can we tell *today* we're going to be more accident prone *tomorrow?*

Certainly, every CO has a gut feeling that today's ops will be more or maybe less safe than yesterday's. Three nuggets flying tonight, and the deck is pitching—an increased vigilance is sensed in "rocket one." That's easy because it's an extreme case, but in fact, most accidents seem to hit when least expected. Maybe the preceding operations weren't all that routine.

Why do gut feelings let us down when we try to prevent the everyday accident? Perhaps it takes a lot more experience and attention than realized to really assess the accident potential of daily ops. Unless one is blessed with exceptional perception, he needs to apply some kind of orderly observation and analysis of today's activities and compare it with the preceding day's results.

Suppose we borrow from the stock market analysts. They have years of experience in predicting the future. Market analysts are generally either fundamentalists or chartists, and they seldom agree on

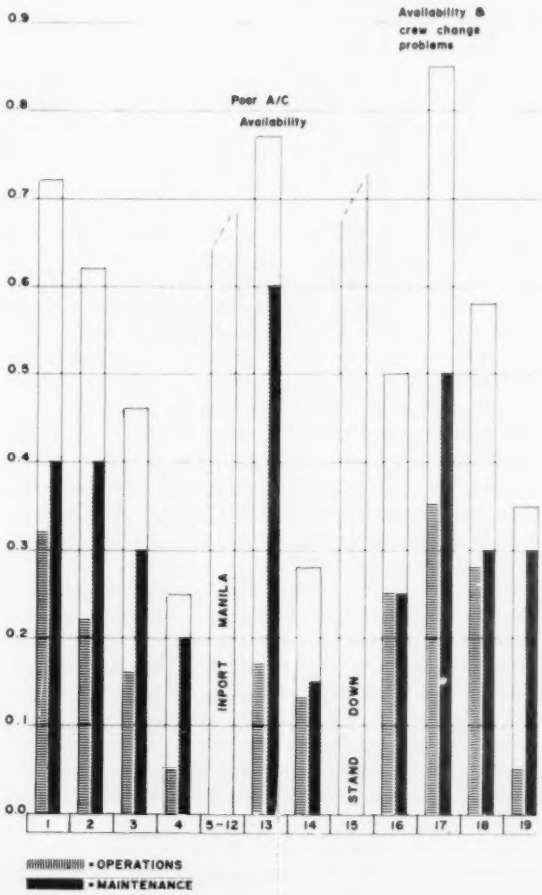


Chart showing deviations per sortie should contain at least 30 days

the forecast. Nonetheless, they have a good handle on what the results were and the trends are.

I submit that is where we have failed in our statistical accident analysis. At the squadron level, we really don't know how we are doing.

The "problem" is that there are not enough accidents within one command to compute a daily accident rate. Hopefully, a command doesn't even have an annual rate. But, there are daily events that can be quantified to compute trends. These events should logically be those that have some functional relationship to the fundamentals of safe or unsafe operations. For example:

- A ground or air abort.
- Failure to complete a mission.
- An unbriefed maneuver or weapon release.
- A change of crew or mission.
- Unscheduled ACM or low-level flight.
- A late launch or recovery.
- A repeat discrepancy on the aircraft or in a COM/NAV system.

To borrow a term from the Air Force, each of these events is a deviation. A deviation in itself may be a positive action oriented toward safety. For example, a ground abort because of a hydraulic leak is much better than accepting a one-rag leaker. It still scores as a deviation, and the command that has a high incidence of ground aborts is likely to be launching a few that could benefit from better maintenance. Put enough deviations together, and they add up to chaos, and a squadron that accepts a high chaos level will sooner or later be shocked by that unexpected accident.

The variety of these deviations suggests that to consider them collectively may be as illogical as adding apples and oranges. But, they all have the common element of being unplanned. They are all indicative of a chaotic organizational "output" that does not reflect the planned or desired management "input." A chart of these deviations could provide a measure of feedback to enable the manager to take corrective action before the output develops into a disastrous accident.

The mechanics of drawing up a chart can be approached in many ways, as any good gundecker knows. In this squadron, the safety officer keeps it active, but the squadron duty officer does the analysis of his day at the helm. Each crew fills out training cards at the end of each flight for the training officer's records. The SDO notes any deviations observed or recorded on these cards, then decides whether the deviation is of management concern to the maintenance department or the operations department. The number of deviations attributed to each department is divided by the number of scheduled events. The deviations are then charted for the day to show the chaos index for each department as shown on the chart.

Use brown for maintenance and blue for Ops, and the total is the command's daily accident prone rating. The criteria or definitions used to score a deviation will have a large effect on the score. But, if deviations are clearly defined, the daily trends within a command can be a clear signal of a changing chaos level.

All this charting and analysis is far from scientific. It is highly dependent on gut feelings that sense which events have relation to the probability of an accident.

Each command would undoubtedly define deviations differently, but a deviation should be an event that the command would like to eliminate. Deviations can't be measured unless people start paying attention to them, and that attention will have an effect in itself. Thus, the indirect effect of trying to see the trend is to create a long term trend toward more orderly and controlled operations. On the short term, there will still be days when everything turns to worms. But if you're watching the chaos index, this is a valuable signal to increase supervisory attention and safety margins.

As shown on the chart, this unit operated on deployment at the rather sick rate of about 0.3—three deviations for every 10 scheduled events. When that rate went above 0.5, we cut back on the schedule and pressed for increased control and supervision in maintenance or operations as appropriate.

I can't prove there is a relationship between incidents and accidents, but it seems reasonable that if the incident doesn't lead to corrective action, the accident can't be far behind. That's what it's all about. Not any scientific discovery, but if you're baffled by all those signs of the zodiac, you might try creating your own horoscope.

USAAAVS
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This is the first of a series of episodes on "who killed George?" George was your unit safety officer—recently departed—about whom many had different feelings. Did George die because of lack of authority, or support—or just from frustration after $32,000 worth of training had taught him a better way?

Who Killed George?

HARDLY ANYBODY noticed the day George began to die. The unit operated on its regular schedule, and the day was filled with so much of the normal confusion that it really is difficult to recall just what the date was. It was the day after George reported, all enthusiastic about the safety program and the things he had learned in school that would help every pilot in the unit live just a little longer.

I remember that day now. The commander was on the phone with a big pile of papers in front of him when George showed up with his little notebook (he had worked for several weeks outlining a program to support the unit's missions and at the same time conserve resources). He motioned George into the office and to a chair while he guffawed into the receiver about last night's return flight from a 3-day boondoggle. In due time George got his turn to present his background and tell how he came to be the tiger captain he was. This took exactly three interrupting and one outgoing phone calls. The last of these calls was made to ensure the photo mission of the proposed golf course site would go like the colonel wanted.

"Now where was I?" asked the commander. "Oh, yes, there is one thing I expect and will have in this outfit, and that is a viable safety program. Make sure the 'read and initial' folder is up-to-date and interesting—you know, girlie pictures and all the things that get the guys' attention. And be sure you keep a log on the FOD walkdowns—one candy wrapper on the ramp and it's the end of the world. Doesn't matter that the roach-coach parks upwind of us twice a day for 30 minutes by the admin building; it's our disaster. And another thing, keep those posters current. There's nothing quite like new posters to make a good impression.

"I expect you to take care of the safety program . . . " The phone rang to remind the commander of the wildlife committee meeting in 5 minutes in the colonel's office and that was the way it ended.

George left the office with his little notebook still unopened.

George died a little that day, but he didn't realize it.

Dare to express an opinion on practically any topic, and chances are excellent that someone will invariably present an opposing viewpoint. However, when the topic concerns the need for safety in Army aviation, even individuals and nations of vastly different ideological backgrounds and customs find themselves in virtual agreement not only as to the absolute necessity for flight safety but also as to some of the prerequisites necessary to attain it. The following article presents the Russian viewpoint concerning this subject; and was translated by the U. S. Joint Publications Research Service from the 5 August 1975 issue of the Moscow KRASNAYA ZVEZDA. It is entitled simply . . .

flight safety

JUST LIKE ALL Soviet fighting men, the pilots and navigators, and aviation specialists of the armed forces and PVO and Naval aviation tirelessly perfect their military mastery. Ensuring the high-quality preparedness of aviation technology and its constant operation on the ground and in the air, and mastering combat skills, aviation specialists attempt to make use of every minute of training time, returning as much as they can for the time spent in training. During intensive flight time, precision and good organization in the conduct of flight operations and strict observance of the requirements and rules which ensure flight safety take on a special importance.

It is under such conditions that flights of the guards air unit, commanded by Guards Lieutenant Colonel V. Tybul'ko, take place. Characteristic for the regiment are high-quality indicators in combat mastery and operations without flight incident and the preconditions for it. And this has been achieved by means of a close organization of the training process and a high state of readiness of flight personnel and technology for carrying out flight assignments. In the unit they have created a model training aids supply, which makes it possible to conduct training, exercises, and flight drawings according to the level of training and required instruction. While showing their concern for increasing the flight training of pilots, their knowledge of the equipment entrusted to them, aerodynamics, and tactics, the commander and party organization exactingly through combat training appraise the achievements of fighting men. Adherence to regulations on the ground and in the air and strict observance of the documents which regulate flight operations make it possible to improve mastery by aviators and new successes in the socialist competition.

High-quality combat training and flight operations without accidents are achieved from year to year by units and subunits. It is obvious that in the outstanding military collectives there is adherence to an orderly system of preventive measures which are directed toward ensuring flight safety and the anticipation of accidents and the conditions for them. The major problem in this work is the generating in people a feeling of responsibility for an assign-

ment and high degree of command demands on specialists. High-class commanders deeply analyze the process of combat training and the operations of personnel, single out and eliminate beforehand the reasons for mistakes, and maintain unconditional attention to observance of flight rules on the ground and in the air.

Why, for example, in the unit which was commanded by Lieutenant Colonel F. Kudrikov up to recently, did the preconditions for flight accidents occur because of blunders by pilots and breakdowns in equipment because of poor maintenance? The reason for these breakdowns is explained, first of all, by a weakening in the commander's exacting attitude and the unsatisfactory organization of measures for flight safety in combat. Purposeful organizational work and training with people, which are called upon to serve as a prevention against flight incidents, are often replaced by the haphazard here, and for this reason its action is not great either.

Life itself and flight practice are evidence enough of how important it is for aviation commanders to make a timely and deep analysis of each concrete instance of mistaken action both in flights and in the course of preparation of flight technology, and objectively appraise the situation on the whole. Only when actual forms of check and control are used and the data from automatic registration equipment is analyzed can the commander get to the bottom of the causes of blunders, which have been permitted in flying or in the maintenance of equipment, and determine the effective ways of eliminating them. No precondition for a flight incident comes into being by itself. It is the result of a breaking of rules of flight service, the organization and conduct of the flight, or the very control of these, and gaps in the knowledge of technology and rules for its exploitation.

The modern airplane or helicopter is a complex unit of automation, electronics, armament, and special gear. And many of the means for its service and maintenance have currently undergone radical changes. All this requires a basically new approach to working on the equipment and the perfection of a method for learning the skills required for its combat operations. And this also means that it is necessary to have a model organization of military operations and its development on the basis of a deep technical knowledge and mastery, not only for the pilot and the technician. Such a requirement now is being made on all specialists, who in some way or another are associated with the service or maintenance of flights.

The growing complexity of modern aviation equipment requires from commanders and officers, who are the chiefs of the aviation-engineering service, a scientific approach to the planning and organization of flight operations. All these assignments must be carried out in a group and in close relation with the perfecting of flight-training-methods schooling of chiefs and purposeful educational work. It is necessary that the concern for the effectiveness and the efficiency of control over the carrying out of flight service regulations be constantly tied to an improvement in commander exactingness, a strengthening of discipline, order, and industriousness, an uncompromising approach to mistakes in the ensuring of flight safety. Special attention to the observance of flight servicing must be given in the process of putting young pilots and technicians into line jobs and in the mastery of new types of combat application.

Commanders and political organizations, and staff, party, and Komsomol organization officers are called upon to instill in each flyer the feeling of personal responsibility for the success of each flight; to explain the necessity of unconditional fulfillment of the requirements of the documents which regulate flight service; to widely propagandize the achievements of outstanding people in the socialist competition, first-class pilots and navigators, and aviation specialists, and the success of accident-free operations; and to constantly search after zero-negligence and zero-irresponsibility.

The flight training of combat men is conducted in an atmosphere of high-quality political and labor activity by combat men, which is evoked by a striving to worthily greet the 25th Congress of the Party of the Homeland. This will make it possible to achieve new levels in the mastery of first-class aviation technology, an improvement in flight safety, and the further strengthening of the combat preparedness of the Soviet Armed Forces.

While the methods for motivation, either proposed or in effect by the Russians, may vary from those of ours, both the problems they are currently experiencing and the solutions they recommend are, for all practical purposes, similar to those of our own. Although flight safety is a command responsibility, it can only be attained by the efforts of each individual associated with Army aviation. And now is the time to take a good look at ourselves and examine our attitude and response to the pressing problems relative to safety. It is also the time to take appropriate action necessary to correct any deficiencies noted—before accidents can occur. Agree?

briefs that teach

ill wind

An OH-58 instructor pilot (IP) and student pilot (SP) received permission to attempt a right pedal fixed antitorque landing with a right crosswind. The IP entered traffic and was planning to demonstrate the procedure. He started by asking the SP to maintain the pedals in a right fixed position at approximately 10 degrees off center to the right. On short final, the nose turned an additional 30 degrees to the right past the 45-degree mark, according to the IP. The IP attempted to roll off the throttle to correct the situation. When this did not align the nose to the runway, he decided to make a power recovery terminating at a hover.

He took control from the SP and attempted the power recovery. The aircraft began a violent spike knock and bucked in a fore and aft gyration which made it impossible to hover. The IP attempted to set it on the ground and during these attempts, the toe and heel portions of the skids hit the ground several times. He finally had to force the collective down to land the aircraft.

The IP asked the SP to take a look at the aircraft. The SP did not get out, but opened the door and looked to the rear on the right side. He told the IP there was no apparent damage. The IP hovered from the runway to the maintenance hangar—approximately 200 yards—shut down, exited, noticed the damage and made an entry on the dash 13.

The IP chose to initiate the nonstandard approach with a right crosswind without first attempting a normal approach to determine the effects of the wind on the aircraft. On short final, the IP determined that the aircraft could not be aligned with the runway by use of the throttle. He attempted a power recovery too late and increased the collective pitch without allowing rpm to return to normal operating range. This induced severe spike knock, which progressed to pylon whirl and resulted in major damage to the aircraft.

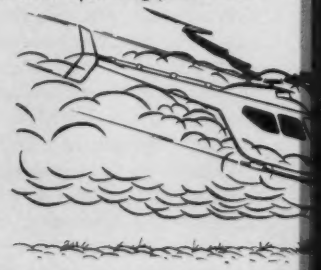
After the landing, the aircraft should have been inspected by maintenance personnel, but instead was hovered from the accident site to the maintenance hangar.

foggy experience

An OH-58 pilot, returning to home base from a field site, contacted home base and obtained their current weather, which was .1 nautical mile (NM) visibility with fog. Reaching the VFR reporting point for home base, he contacted ATC and requested entry into the control zone. The tower denied permission because of low visibility.

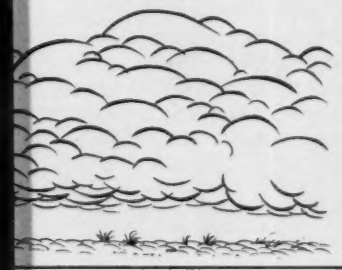
The pilot held over the VFR reporting point for a short time, then requested overflight of the airfield. Home base ATC told him that transition or overflight would be at his discretion. He made the overflight of the area and stated that he could not see the airfield. He returned to the reporting point and stated that the visibility was 2 to 3 miles. A short time later home base ATC told the pilot that visibility had reached .5 NM with fog.

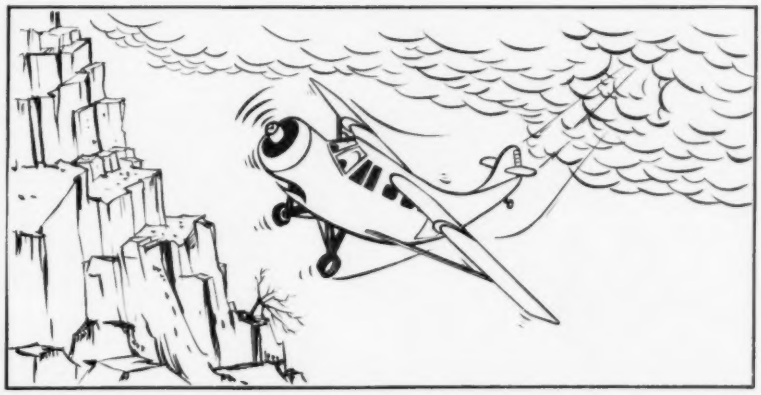
Receiving the weather observation from the tower, the pilot requested a special VFR entry which was granted. The tower asked him what his entry point was. He told them and said that in-flight visibility was down to .1 mile and that he would return to the reporting point and



hold VFR. The visibility at home base soon went up to .7 NM and the pilot was advised of this. He then requested another overflight to see if he could see the runway. The tower again told him to proceed at his discretion and the pilot stated he intended to overfly the airfield. A few minutes later ATC contacted the pilot and asked him for a position report. He replied that he had inadvertently encountered IMC and needed help. The tower told him to climb to 3,000 feet, home to the beacon and hold until further instructions. This was the last contact with the OH-58. Police later notified ATC that the aircraft had crashed.

The pilot was inexperienced with the weather conditions found in the area. He was unable to successfully recover from the instrument meteorological conditions which he encountered because: (1) The aircraft was not equipped with an attitude indicator. (2) He had no instrument flight experience and no partial panel practice during the past 5 months. (3) He probably became disoriented and experienced vertigo.





get-homeitis

At 1050 on Friday, a U-1A pilot and his mechanic departed for home base and flew 2 hours VFR before stopping for fuel and lunch. After lunch, the pilot filed with the local flight service station and departed at 1425. The weather was still VFR during the second leg and no difficulties were encountered during this 3-hour portion of the flight.

Landing to refuel, the pilot filed and got a weather briefing by telephone at the flight service station. The weather briefer suggested that better weather would be along a route different from the route the pilot originally planned to take. The pilot agreed and received his destination forecast weather.

They departed at 1855 VFR for home base. The pilot filed for 3,500 feet en route altitude but advised that he would be climbing higher when he opened his flight plan after takeoff. Both pilot and mechanic stated how well they could see the surrounding mountaintops. The aircraft began entering scud layers and clouds at 5,500 feet at 2126. The pilot then elected to descend to remain VFR. After seeing lights through the haze and clouds he realized he was too low and initiated a climbing 180-degree left turn in an attempt to return to VFR.

Within a few moments the aircraft crashed into a mountain while in a very shallow climb. The crash occurred at 2140, 2 hours and 45 minutes after departure from their last stop. The pilot had flown 7 hours and 45 minutes that day. Total elapsed time was 10 hours and 50 minutes. The pilot and mechanic escaped with injuries.

This accident was caused by the pilot penetrating instrument meteorological conditions at night and trying to descend to regain visual conditions. After realizing he was very low, he initiated recovery actions while IMC and crashed into the mountain. The reason for this mental error by the pilot can be attributed to fatigue and get-homeitis.

The pilot violated regulations and the unit SOP by flying more than 6 hours in a 24-hour period without a qualified copilot.

IMPROVED MAINTENANCE INSPECTION

TECHNICAL RESEARCH directed at improving safety and reliability in all areas of military operations, to include aviation, is a constant effort and concern of all the services. A part of this effort is a feasibility study of applying neutron-radiography for improved maintenance inspection of aircraft and aircraft components. The study was performed by Intercom Rad Tech under contract to the Naval Air Development Center (NAVAIRDEVCEN). The work researched the application of a "252 cf-based neutron radiography as a nondestructive inspection technique."

Neutron radiography is a nondestructive inspection technique that is similar in principle to x-ray, in that a penetrating radiation (neutrons) is used to obtain a visual image of the internal form of an object. The transmitted neutron beam is detected and permanently recorded on a suitable imaging system (usually film). The recorded image represents a shadow of the object with the lower density on the image corresponding to portions of the object that are more effective in attenuating the direct neutron beam. The objective, as discussed and presented during the Joint Services Safety Conference for 1975, is to improve and facilitate maintenance inspection by minimizing assembly/disassembly requirements of aircraft and aircraft components.

It is a proven fact that maintenance of today's aircraft is a very complex, time-consuming and expensive operation. Both scheduled and unscheduled maintenance routinely require some means of nondestructive inspection. While visual inspection by trained, experienced and qualified inspectors and technicians still remains one of the best methods of detecting defects and damages, it is restricted to that part, component or area easily accessible to the eye. Accordingly a multitude of reliable nondestructive inspection techniques have been developed to supplement visual inspections and are in wide use today. Such techniques include magnaflux, dye penetrant, eddy current, ultrasonic and x-ray.

Neutron radiography, or n-ray, is now an additional nondestructive technique available to supplement those other techniques for optimum safety in man/machine environment. Although n-ray and x-ray techniques are similar in principle, they actually complement each other. This is because the relative absorption characteristics of most elements are essentially reversed; thermal neutrons are highly attenuated by light elements (principally hydrogen), whereas x-rays are attenuated more by heavy elements. Thus with n-rays, nondestructive inspection can be made of light elements or certain defects encased in or behind heavy elements. It can detect imperfections in thick samples through which x-rays cannot penetrate, or in samples containing hydrogenous matter or contaminants whose neutron absorbing and scattering properties differ significantly from the base material.

The Navy study indicates that the n-ray technique is unmatched in "its ability to detect surface corrosion, even when hidden behind metallic structures several inches thick." The detection of hidden surface corrosion is only a sample of the nondestruc-

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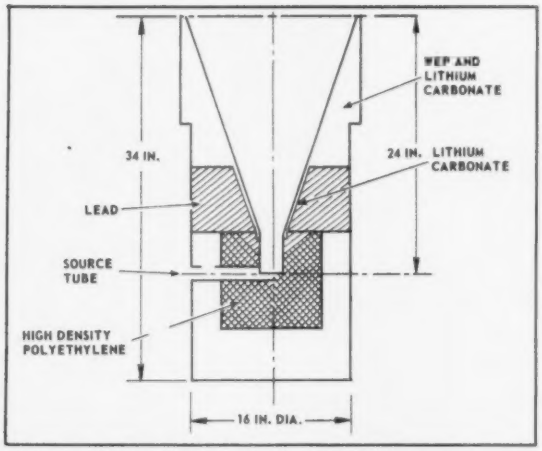


FIGURE 1.—Schematic of prototype camera showing principal components

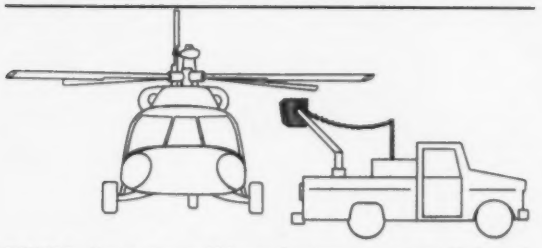


FIGURE 2.—How system could be used to inspect main rotor blades without disassembly

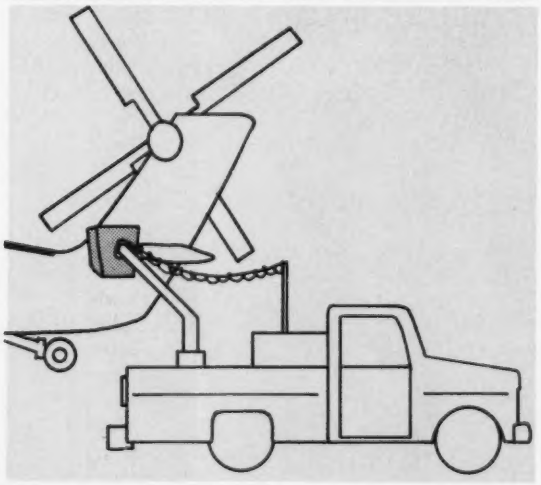
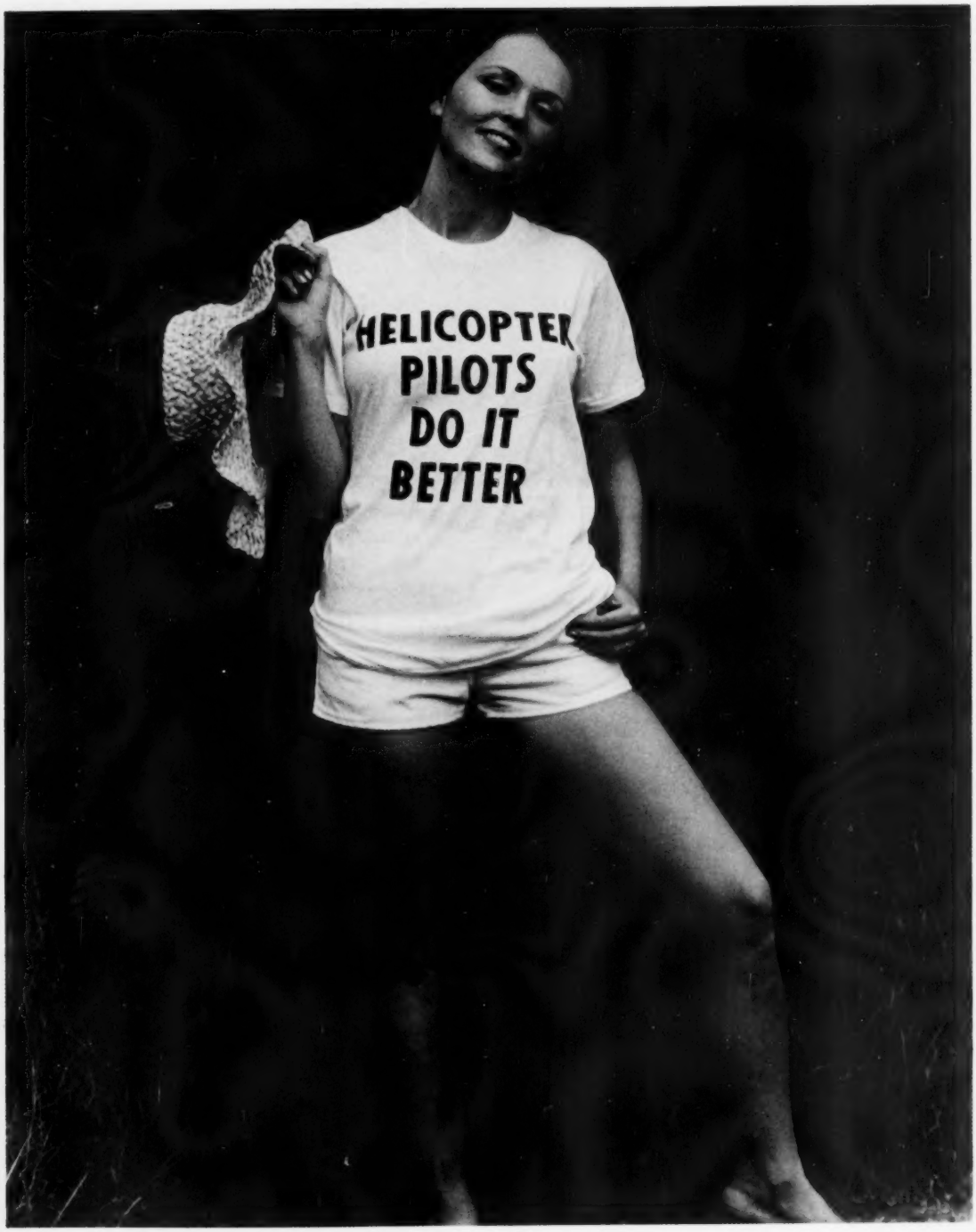


FIGURE 3.—How system could be used to inspect tail pylon and 42-degree gearbox area

tive inspection capability of the n-ray technique. Some examples "not amenable to inspection by other nondestructive inspection" methods are the examination of adhesive-bonded honeycomb assemblies (widely used in helicopters), the detection of water or voids in honeycomb, the inspection of printed circuit boards, the coking of fuel manifolds or ignitors, the inspection of oil filters for foreign substances and the examination of metal brazed honeycombs, to name but a few. The n-ray technique is being evaluated to optimize aircraft maintenance based on precise information for structural and material condition of the aircraft component or assembly. Such information is vital for assessment of operational readiness, especially for aircraft having extended service tours or lengthened progressive aircraft rework intervals. A lighter and relatively less expensive but more efficient camera system "capable of inspecting components and structures on the aircraft without even partial disassembly" (figure 1) can be developed for use of field units.

In a world of increasing need for safety awareness and the preservation of aviation resources, one can easily conclude that adaptation of the n-ray technique would complement existing nondestructive inspection techniques if located at depot level, rework facilities and/or maintenance supporting units close to operational units (figures 2 and 3). The 252-cf system can be cost effective and requires "no maintenance, no elaborate control and safety system, nor external power supply." N-ray was previously possible only with nuclear reactors. The recent availability of a manmade material, Californium-252, has made it possible to develop n-ray systems where a nuclear reactor is no longer necessary. This has resulted in a substantial reduction in capital cost, as well as considerable savings in cost of operation. Application of the n-ray technique would enhance safety through nondestructive inspection of helicopter blades, filter elements and engine turbine blades, plus vital detection of water or voids in honeycomb panels.

This article is only a brief extract of the work done for NAVAIRDEVCEN on the application of neutron radiography techniques. Further information and complete details of the studies to include the fundamentals of the technique, the neutron radiography system and proposed camera details can be found in the interim report prepared by Intercom Rad Tech for the Analytical Rework/Service Life Project Office, Air Vehicle Technology Department, NAVAIRDEVCEN, Warminster, PA 18974.


HELICOPTER
PILOTS
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BETTER

PEARL'S

Personal Equipment & Rescue/Survival Lowdown

If you have a question about personal equipment or rescue/survival gear, write Pearl, USAAAVS, Ft. Rucker, AL 36362

Explosion of Distress Light Marker

A Navy pilot was seated in his aircraft with the distress light marker, NSN 6230-00-892-5192, attached to his life vest. The light exploded and the force of the explosion was directed downward. The vest was stained and plastic chips and the battery head were scattered on the aircraft floor.

It is suspected that the explosion was caused by a buildup of pressure within the sealed light case due to corrosion and battery leakage. This occurred despite the fact that the life vest and components were inspected less than two weeks before the mishap. Luckily, the explosion occurred while the aircraft was on the ground rather than in flight. More importantly, if the light marker had been installed upside down on the life vest, the consequences to the crewmember could have been very serious.

This mishap points out the obvious need for inspections and planned periodic maintenance on life support equipment. Corrosion is one of the ways that batteries communicate with people to let them know that something is awry. Thus, a simple preflight check of batteries could possibly prevent a potentially fatal mishap.

When did you last take your light marker apart and check the batteries? If you put it off, this little lifesaver could come back to haunt you. So, do it now!

SRU-21/P Survival Vest

I would like any information you have that would help me in giving a class on the SRU-21/P survival vest.

TM 55-8465-215-10, "Operators Manual for Vest, Survival, SRU-21/P, Hot Climate," is the best source of information on the vest. This TM is issued as a component of the survival vest and is available through normal publications supply channels. The back cover of the November 1974 *ARMY AVIATION DIGEST* pictures the vest and components, along with a complete listing of national stock numbers and nomenclature for each of the items. Also, the November 1972 issue of the *DIGEST* has a short article on the survival vest which you may want to check for background information.

Survival Radio Operation

To achieve maximum performance of survival radios, crewmembers must be familiar with the capabilities and limitations of the radios. As an example, a survival radio best performs with the antenna at a right angle to the ground. So when using the survival radios, keep the antenna straight up, rather than pointing it at the rescue aircraft. Refer to TM 11-5820-800-12 for additional information on proper operation of survival radios.

The signal pattern of survival radios is line of sight. The distance of transmission is based on maximum battery power as well as the height of your transmitting location.

Prior to a mission, the battery should be checked with a reliable battery tester. If spare battery is sealed in original packing material, remove and check for maximum power output. Improper storage of batteries decreases the operating life. Refer to SB 11-30 for storage instructions.

For more information, contact Aviation Life Support Systems Manager, ATTN: AMSAV-WL, U.S. Army Aviation Systems Command, P.O. Box 209, St. Louis, MO 63166, AUTOVON 698-3241/3291.

SRU-21/P Survival Vest Holster

We have had a few cases where people failed to sew the holster on their SRU-21/P survival vest and consequently cannot locate the sew-on holster. In the November 1974 AVIATION DIGEST you listed a breakdown of the SRU-21/P, but listed the sew-on holster as a part of the vest itself. Can you provide an NSN and a supply reference for the sew-on holster?

The holster which is supplied with the SRU-21/P survival vest is furnished by the contractor and has no separate NSN. The holster is not available through normal supply channels. It appears the only recourse for a loss of this item is to purchase another vest, without components, NSN 8415-00-177-4818.

USAASO Sez

FAA establishes joint-use airspace

IF THE AIRSPACE I want to use is over my installation, I don't have to ask anyone if I can use it."—Don't you believe it!

Public Law 85-726, commonly called the Federal Aviation Act of 1958, directs the administrator of the Federal Aviation Administration (FAA) to develop plans and formulate policy with respect to the use of the navigable airspace; and assign by rule, regulation or order the use of the navigable airspace under such terms, conditions and limitations as he may deem necessary in order to ensure the safety of aircraft and efficient utilization of such airspace. He may modify or revoke such assignment when required in the public interest.

That little jewel gave all the airspace to FAA! True; however, that doesn't mean that the Army can't get its required share for operations and training. There is a little thing called "joint-use airspace" which allows the FAA to establish joint-use restricted areas for Army use as required. Joint-use restricted areas in the Continental United States (CONUS) are restricted areas for which "using agencies" and "controlling agencies" have been designated in accordance with a "Letter of Procedure." The "using agency" in this case is the Army and the "controlling agency" is the FAA. Designation of the FAA as the controlling agency in Army restricted areas is for air traffic control purposes *only*, and applies *only* during the period when the area is released to the FAA. Such designation does not negate, compromise or modify Army control or use of the area. So, even though an Army restricted area may be designated as joint-use airspace, we don't lose control of it. Our partner, the FAA, must first get *permission* to use it and must return it to the Army user as our needs dictate.

That same public law which gave all the airspace to the FAA also recognized that in order to support national defense, military requirements must be considered.

Don't miss it!

The April issue of the *DIGEST* will have a translation of the article "NATO Views On Employment of Airborne Assault Forces." It was written by Professor Colonel M. Belov, Doctor of Military Science of the USSR and recently appeared in the Russian Army newspaper, *Red Star*.

Ft. Rucker Reorganization

A MAJOR reorganization of the U.S. Army Aviation Center at Fort Rucker became effective on the first of February. The reorganization is part of the Army's plan to bolster its training system and implement an improved flow toward the goal of combat readiness.

In the new organizational structure, Colonel Colen D. Ciley Jr. is the Deputy for Training Developments (DTD). Heading the other elements are Colonels William R. Ponder, Deputy for Combat Developments (DCD); Edward J. Porter, Deputy for Training (DT); Clement A. Wyllie, Deputy for Standardization (DS); and Anthony J. Adessa, Commander of the Aviation Troop Brigade, the troop management and housekeeping organization at Fort Rucker. (See *U.S. ARMY AVIATION DIGEST*, September 1974, for details of the former organization.)

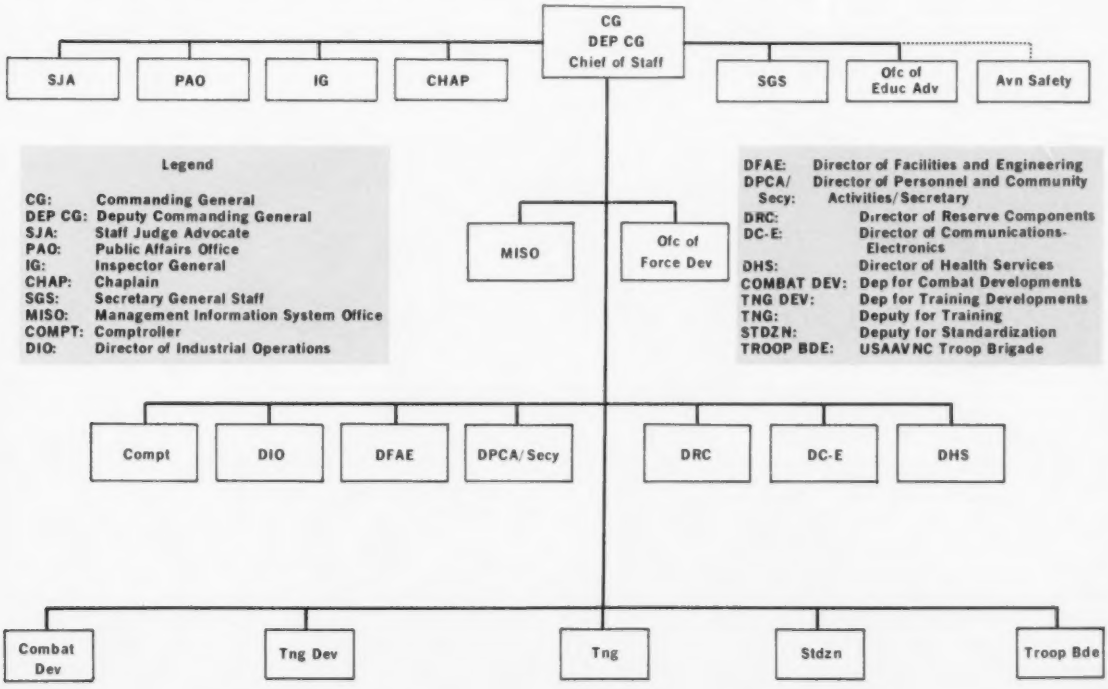
DCD develops concepts, doctrines and materiel requirements for aviation combat; DTD determines and develops methods to teach the use of the materiel and the employment of the doctrines; DT trains people with the methods developed; and DS evaluates the process independently to assure accomplishment of Army aviation's part of the combat readiness role.

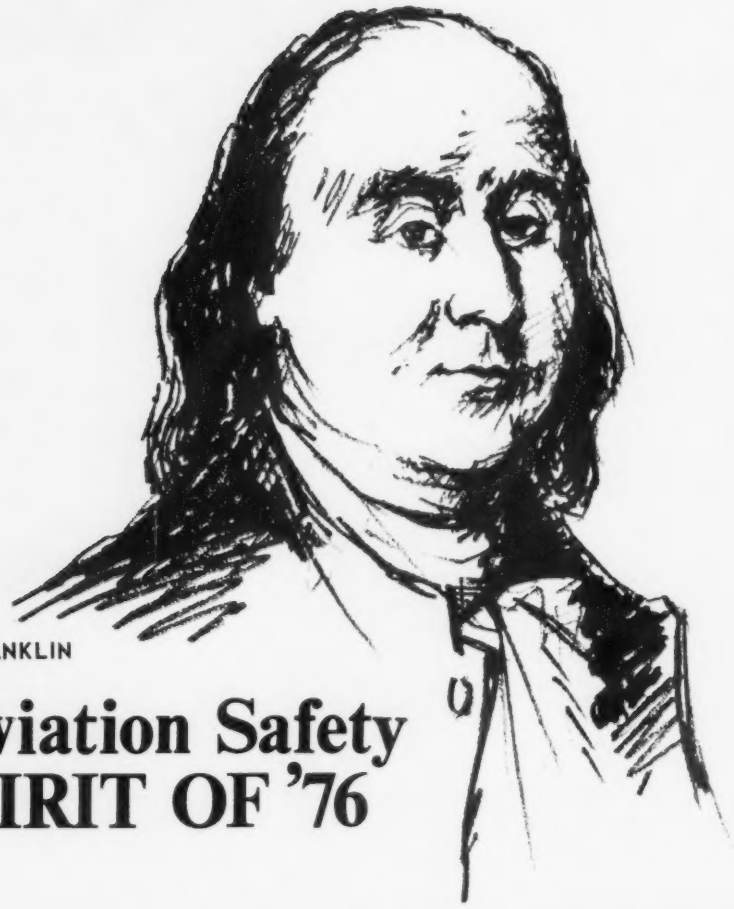
Included in the mission of the newly formed Deputy for Training Developments is the development, monitorship and improvement of aviation training programs. Decisions as to what and how to teach will be made by this agency rather than the Deputy for Training. Pulled from other agencies and placed under DTD is the preparation of training literature. The *U.S. ARMY AVIATION DIGEST* also has been placed under DTD.

The development of instructional packages for active and reserve units to use in aviation training is a function of DTD. However, the dissemination of these packages and the liaison is done by DT.

A new job for DS is that of the Aviation Center's "independent evaluator." In this role DS collects and analyzes data that identifies problems within the aviation training system. This information is given to the other agencies so appropriate remedial action can be taken.

The brigade also assumes new responsibilities. It now provides support for allied military training, prepares and maintains installation plans and operates the emergency operations center. The first function was formerly under the Director of Personnel and Community Activities; the other two came from DT.





BENJAMIN FRANKLIN

Make Aviation Safety The SPIRIT OF '76

"...we may give advice, but we cannot give conduct."

Just nine short words spoken by Benjamin Franklin 200 years ago. Profound? Yes! But look at them again. Applied to Army aviation, they literally spell out a principal cause of accident after accident—a lack of professional discipline. Failure to voluntarily comply with common-sense safety practices causes the same errors to be committed over and over. Often, the end results are tragic.

Some aviation people act like the man whose vision is blurred, causing him to stumble in broad daylight. Yet, in the pocket of his coat, he carries glasses especially prescribed for him. All he has to do is put them on. But he refuses to believe they will help him. He continues stumbling and groping. Sooner or later he's going to fall.

Let's stop discarding proven safety practices and put on the spectacles prescribed for us.